Engineering News

VOLUME 70 DECEMBER 18, 1913 NUMBER 25

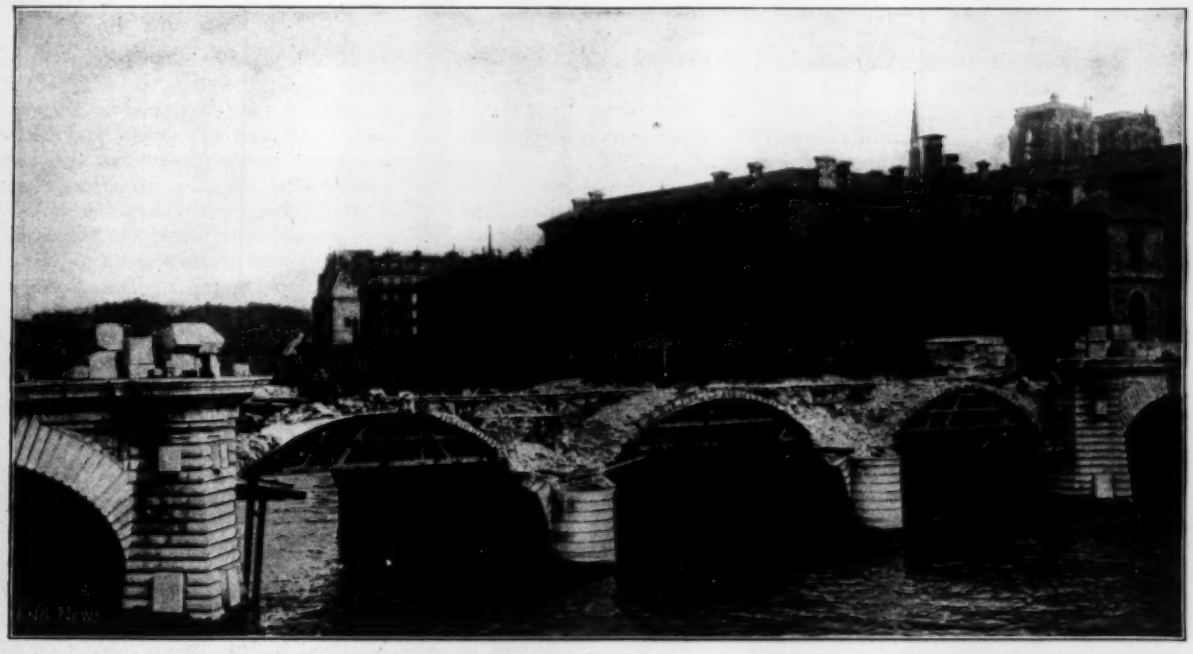
Pont Notre-Dame Reconstruction, Paris; Arch Replacement under Traffic

An unusual and difficult piece of bridge reconstruction is being carried out in Paris. The Pont Notre-Dame, one of the many stone-arch bridges crossing the Seine, is being improved by substituting a single steel-arch span for several of its stone arches, to enlarge the channel of the river. The following notes are from a visit to the work and information collected on the ground by a member of our editorial staff.

The Pont Notre-Dame crosses the north branch of the Seine where it is divided by the Ile de la Cité, and forms one of several connections between the important part of the city lying around the Hotel de Ville with the island, and (by way of other bridges over the south branch) with the south half of the city (*rive gauche*). The bridge up to now has consisted of five stone-arch spans, and thus had four piers in the river. These piers seriously contracted the channel capacity.

The cross-section of the Seine is inadequate during extreme floods (such as that of 1910*), and the obstructive effect of the piers of certain bridges is felt even at ordinary highwater. The throttling effect of the Pont Notre-Dame is due to two causes: (1) there are four piers, while most other bridges have but one or two, and (2) the pier foundations, four centuries old, are too shallow and (with the protective rock fills around the pier bases) too much spread to permit of giving the river channel its regulated depth. For over 15 years the resulting contraction of channel area has been recognized as objectionable. However, plans for improvement did not come to a head until about three years ago. It was then decided to carry out a project devised by the engineers of the Navigation de la Seine, involving the removal of the two middle piers by taking out three arch spans and building one steel arch in their place.

The work had to be done without closing the bridge to traffic, since both for vehicle traffic and for street-railway service the Pont Notre-Dame is a main artery of communication. It was decided that only half the width of the bridge should be closed at any one time. Under this hampering condition the work became especially difficult, and its successful performance (the work is now nearly completed) is a notable feat.

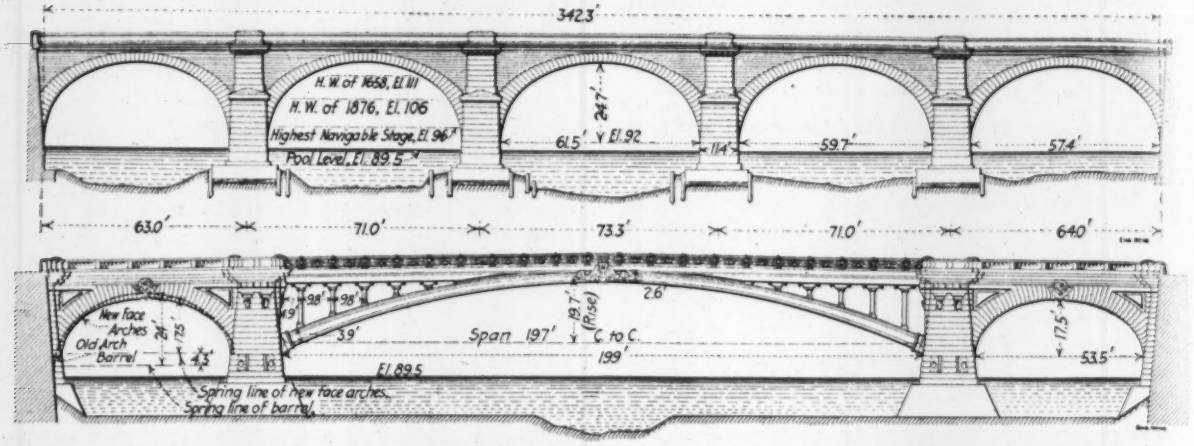


PONT NOTRE-DAME: TRAFFIC MAINTAINED ON EAST HALF WHILE WEST HALF IS BEING DEMOLISHED

The design of a satisfactory construction and method of work was complicated by the great age of portions of the bridge. According to an official record of Paris bridges, the Notre-Dame bridge originally was a wooden structure, built about 1400 and carried away by a flood in 1499. Then a stone-arch bridge was built by Brother Joconde, an Italian monk, during the years 1500 to 1507.

*An account of the extensive flooding caused by this high water was given in "Engineering News," Mar. 24, 1910.

This stone bridge consisted of six arches, one of them lying under the south wharf and forming there the outlet of a canal; the other five arches practically coincided with the five of the present bridge. The roadway was lined with a row of houses on either side, which left only a 20-ft. roadway between them, until 1786, when the houses were cleared away. All but two of the arches were obstructed so that water and boats could not pass through them, and the current through the two openings was, therefore, very strong. Rock fills around the bridge piers protected them from injury by scour, however.



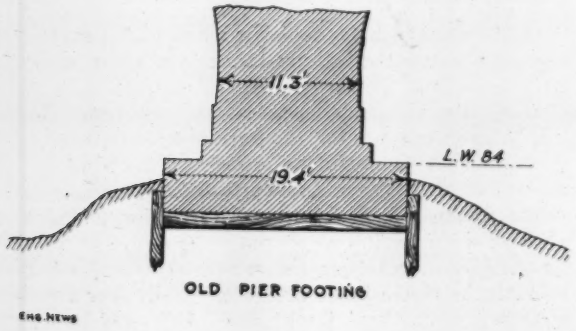
FIGS. 1 AND 2. PONT NOTRE-DAME, PARIS, BEFORE AND AFTER THE PRESENT RECONSTRUCTION

In 1852, a lowering of street grade on account of opening a new street, the Rue de Rivoli, along the north bank led to reconstruction of the bridge. The old structure was taken down to low-water level and new piers and arches built above this point. The stones of the old bridge were used to a large extent in the construction of the new. Including some river-wall work, the cost of this reconstruction was nearly $200,000.

The present reconstruction, as will be seen from the following description, utilizes a considerable part of the 1854 bridge, and, by retaining the foundations of certain of the piers of that bridge, it also utilizes some portions of the structure of 1500.

Fig. 1 shows in side elevation the bridge as it has existed up to the present. A corresponding elevation of the bridge as it is being reconstructed is given in Fig. 2. The changes are: (1) Substituting a single steel-rib arch for the three middle stone arches; (2) strengthening the two piers on which the steel arch is supported, by spreading their foundations and incidentally thickening the pier shafts, and (3) adding new face arches in the two flanking stone spans. There is some other work in renewing the face masonry, etc., for the desired architectural modernization.

The pier reinforcement had to be done before any of the other work, to provide for the changed conditions of arch thrust during and after the reconstruction. Prior to placing the new arch, the three stone arches would have to be demolished, and therefore the pier nearest the shore would have to stand temporarily under the thrust of the shore arch without any thrust on the river side. After placing the steel arch, the thrusts against the pier would also be out of balance, whereas, in the original condition of the bridge the stone arches exerted balanced thrusts against each of the piers. The old pier bases were not thought adequate for the conditions of unbalanced thrust.



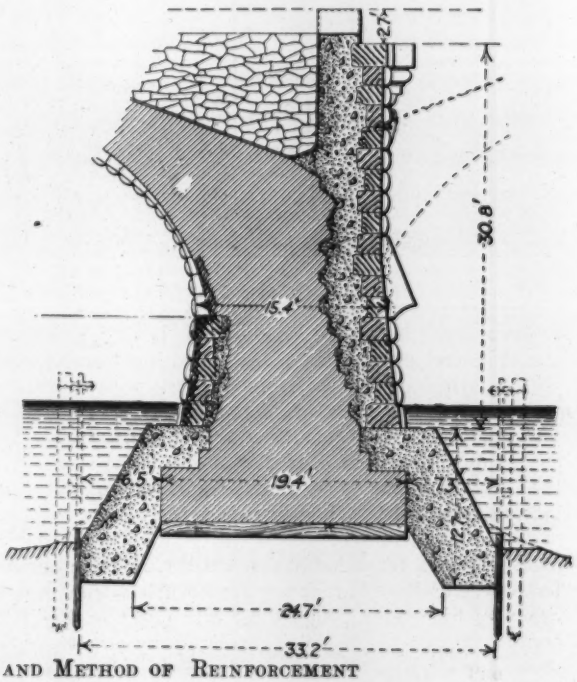


FIG. 3. PIER OF PONT NOTRE-DAME, AND METHOD OF REINFORCEMENT

d they were widened (and deepened) as shown in g. 3

The old pier foundations are those of the bridge built n 1500 (since the reconstruction of 1852 to 1854 in-

FIG. 4. THE PONT NOTRE-DAME UNDER CONSTRUCTION, APRIL, 1912

(Pier foundations reinforced, shore arches faced with new cut-stone masonry, three middle arches being stripped preparatory for demolition.)

volved the structure above low-water level only, the new piers being built on the old pier bases). These old foundations are sketched in Fig. 1, and more fully in the left half of Fig. 3. A footing of stone rests on a timber platform on wooden piles, practically at the level of the river bottom. Protection against scour is afforded by sheetpiling outside of the timber platform, and surrounding riprap or rock fill. The old work was known to be in good condition, and the reconstruction plan was based on utilizing the old footings and adding additional footing area outside.

The arrangement of reinforcing-masonry shown on the right in Fig. 3 was adopted. As the bottom was known to be good firm gravel, and the new footing was to be extended down below scour, no piling or other foundation preparation was employed. The corbeled-out footing was tapered to the pier shafts well above the level of the old pier base. On the river face of the piers, the reinforcing masonry was carried out farther than the old line of the pier shaft, thereby thickening the pier about 1 ft. and correspondingly shifting the center line of the piers about 6 in. toward midstream. The new pier and facing masonry on the river face was continued up, carrying the stone skewbacks for the steel-arch ribs and continuing upward to form the abutment wall and bridgeseat at the end of the floor of the steel arch. All this work could not be executed at one time, as the pier reinforcing had to be done before the old middle-arch span could be removed, and, therefore, before the river face of the pier could be reconstructed above the springing line of the old arches.

Sheetpile coffer-dams were driven around the pier as a beginning. The inner line of sheeting was just on the outer line of the newly spread pier-base. The outside of the sheeting was thoroughly calked and then the interior pumped dry and excavated, without disturbing the old grillage and pier footing. The reinforcing masonry laid up in the excavation was carried up with cut-stone facing, of the new design, the old face masonry being torn out.

At this time also the faces of the two land arches were reconstructed. Both static and architectural considerations favored the replacement of the land arches by new ones of flatter proportions, in order that these arches might balance, both actually and in appearance, the greater thrust of the long-span central steel arch. However, only the architectural considerations were weighty enough to demand a change, and these could be met by change in the face masonry alone (the face stones having

FIG. 5. PONT NOTRE-DAME: WEST HALF OF ARCHES DEMOLISHED AND FALSEWORK FOR STEEL ERECTION PLACED (OCTOBER, 1912)

to be replaced in any event, because of architectural changes in finish, etc.; compare Figs. 1 and 2). Therefore, the constructors resorted to the expedient of building the new face masonry as an arch of lower rise and different shape from the old arch barrel, leaving the latter undisturbed, however. A comparison of the inner line of the arch barrel and the line of the new face arch is indicated in Fig. 2, where the barrel is shown by a dotted line.

The appearance of the bridge when this phase of the reconstruction had been completed is shown by the photographic view, Fig. 4, representing the downstream face of the bridge, looking from the north bank toward the island. This view also shows the beginning of work on the demolition of the three middle arches. Roadway paving and arch fill were removed, then centers placed in the arch spans (p. 1211), and finally the arch masonry removed down to a short distance above the springing line of the old arches, to give room for the falsework trusses from which to erect the new steel arches. The latter stage is represented in Fig. 5, which, however, is a view in the reverse direction, looking from the island toward the north bank.

In Fig. 5 an intermediate item of work is also represented, namely, the reconstruction of the river faces of the main piers after the demolition of the middle arches. The pier on the far side of the river shows the old face masonry removed in the upper half, and the new face masonry already completed up to and including the skewback blocks for the steel ribs.

From this point on, the remaining construction work offered no particular difficulties: erection of the steel ribs and placing of roadway framing, slab and paving.

All the work hitherto described (except the pier-base reinforcement) was confined to the westerly half of the width of the bridge, traffic being maintained on the east half. When the west half of the bridge was completely reconstructed, traffic was diverted to it, and the east half then demolished and rebuilt in the same way. At the present time considerably more than half the width of the bridge is entirely completed and only two or three steel ribs on the easterly side remain to be placed.

One important item of work still remains to be done, the removal of the two middle piers, which up to the present have been left standing under the new steel arches. As soon as they are no longer required for the support of the falsework from which the steel is erected, the masonry will be torn away down to low-water level and then the removal of the parts below water undertaken with coffer-dams. The engineers are planning to use steel sheetpiling of American type in this work, driving a single line of sheeting and bracing it inward to the pier masonry, relying on the interlock of the steel piles to make the wall water-tight so that the pit can be pumped out.

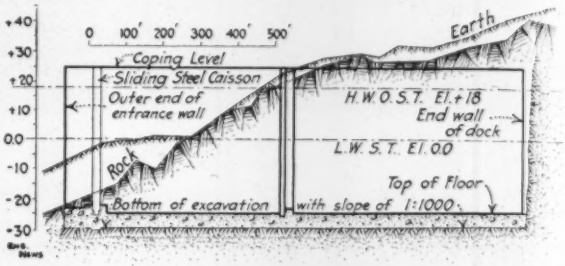
The final completion of the work will involve some deepening of the river bed, inasmuch as the bottom at this bridge has not been down to the elevation fixed upon by the river engineers for the regulated channel of the Seine.

This bridge reconstruction was done under Mr. Aron, Engineer of the Navigation de la Seine, and was under the direct supervision of Mr. Rétraint, as Resident Engineer.

A New Dry Dock on the St. Lawrence River at Levis, Quebec

A dry dock of record size is now being built by the Department of Public Works of the Dominion of Canada on the St. Lawrence River opposite Quebec. The contract for the construction of the dock was let some months ago and the work was dedicated by the Premier of Canada on Oct. 24, 1913.

The dock is to be located on property acquired by the Canadian Government in the village of Lauzon, two miles east of the town of Levis, Quebec, opposite the city of Quebec and in close proximity to a small government dry dock now in use. The dock is to be built of concrete masonry founded on solid rock. It is to have the following dimensions: Length from caisson stop to headwall, 1150 ft. divided into two parts, 650 and 500 ft. respec-



PROFILE THROUGH CENTER OF DRY DOCK

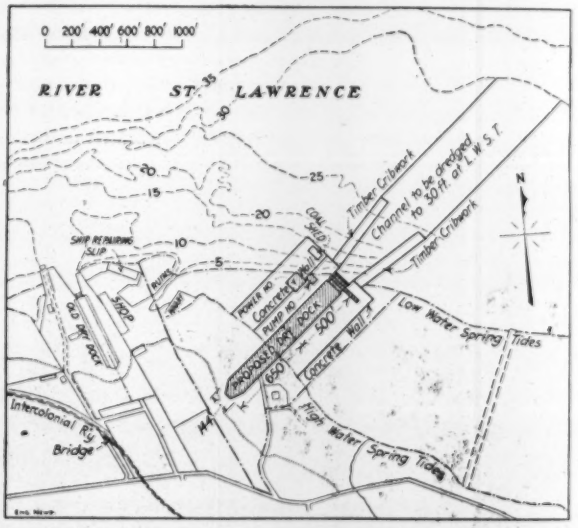


FIG. 1. GENERAL LOCATION OF DOMINION OF CANADA DRY DOCK, LEVIS, QUEBEC

tively, so that for smaller vessels the mid-caisson stop may be used; width of entrance, 120 ft.; depth on sill at ordinary high-water spring tide, 40 ft. The outer entrance will be closed by a steel rolling caisson and a steel floating caisson will be used to close the inner entrance or, in case of emergency, the outer entrance. It will be emptied by three centrifugal pumps, each having a capacity of 60,000 gal. per min., the pumps being run by a set of three turbo-generators. An approach channel dredged for the present to a depth of 30 ft. is to be guarded at the entrance to the dock by concrete-block

walls founded on timber cribs, spread in plan to give a funnel-shaped entrance to the dock.

General Details

Fig. 1 shows the general location of the dock and, on the longitudinal section, the nature of the material in which it is to be built. It will be noted that the amount of dredging for the dock proper is very small as is also the earth excavation; practically the whole excavation for the dock is to be made in rock. The bottom of this excavation is to be sloped with a grade of 1 to 1000 from the head of the dock to the entrance, and under drains in the location shown in the cross section in Fig. 2 are to be excavated under the floor of the dock to carry away any water which may be borne in the rock.

General details of the rock are given in Fig. 2, which shows two typical half-sections through the dry dock.

The section is 144 ft. wide at the top of the coping (although the entrance, as shown in the drawing, is reduced to 120 ft. by the gates) and is 120 ft. wide at the bottom. It has a depth of somewhat over 40 ft., but the entrance sill reduces the usable depth to 40 ft. at the bottom. This section consists of two solid concrete sidewalls integrally connected to the solid concrete floor, all footing on rock. The sidewalls are of gravity type where they have to support any amount of earth fill, that is, near the entrance where the rock bottom begins to slope down. At the land end the sidewalls act merely as lining to the rock face of the excavation, although they retain on the interior face the same profile as the gravity walls. Whenever the gravity walls are built higher than the natural surface of rock, they will be backfilled with puddled clay for a thickness of 3 ft. and behind that the regular earth filling will be used. The walls are provided with altars of the dimensions shown in Fig. 2 and are curved in small steps to make the connection with the floor. All of the wall construction is of concrete, except the copings at the top of the wall and on the altar levels; these copings are of cut granite.

The sidewalls are to be built in alternate sections of approximately 30-ft. lengths, each of which will be finished with a V-joint 1 in. in depth. Between the sections expansion joints ¼ in. wide are to be left. A vertical recess or groove is to be molded at the end of each concrete section being built, and this is to be filled with grout after the walls are completed.

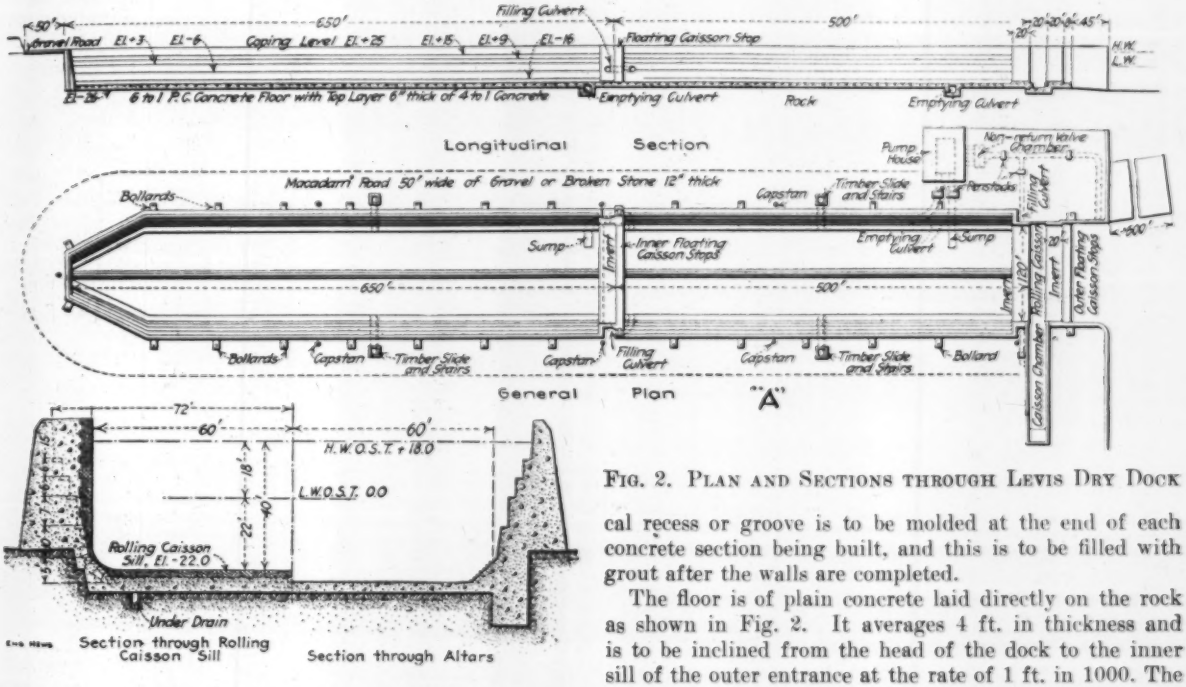


Fig. 2. Plan and Sections through Levis Dry Dock

The floor is of plain concrete laid directly on the rock as shown in Fig. 2. It averages 4 ft. in thickness and is to be inclined from the head of the dock to the inner sill of the outer entrance at the rate of 1 ft. in 1000. The elevation at the center line is to be 6 in. higher than the side, where a gutter 6 in. deep is to be formed, and this gutter leads to the pump sumps which are described further below. The center of the floor is to be provided with three rows of granite block, the middle row 4 ft. wide and

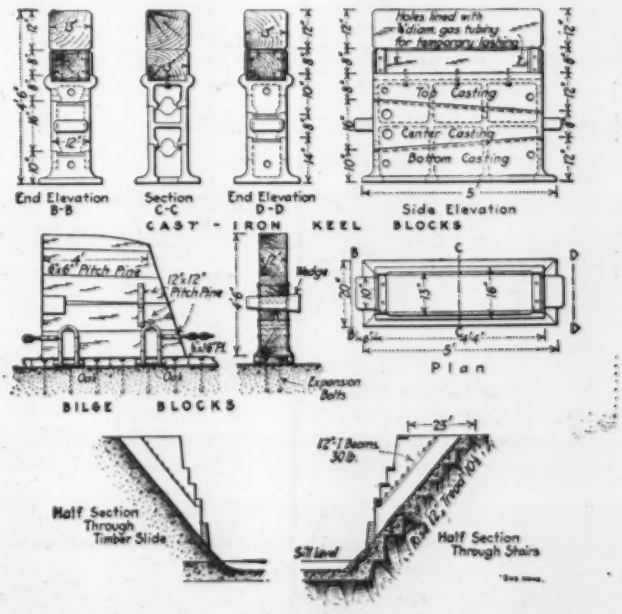


Fig. 3. Details of Timber Slides and Supporting Blocks

level, and the other two rows 3 ft. wide, and conforming to the crown which the floor is to be given. The floor also is to be laid in alternate sections with the same type of expansion joints as are noted above for the walls.

The head of the dock is V-shaped in plan, continuing the gravity section of the back of the wall but not the altars. Stairs are to be built in the walls of the dock as indicated in the drawing, two in each division with 12-in. treads and 12-in. risers molded into the concrete

ber (Fig. 2), resting on the timber sills, and it is pu[lled] out across the dock to form the closure when requi[red]. A water-tight deck of steel plate is to be placed [at] a height approximately 23 ft. from the bottom, and on [which] the rising tide will be allowed to enter by openings of [sufi]ficient sectional area to permit the water covering [the] deck at the rate of 4 ft. in height per hour with the fl[ood] tide, thus preventing the caisson from floating. [Six] water-tight steel culverts, approximately 10 ft. squ[are]

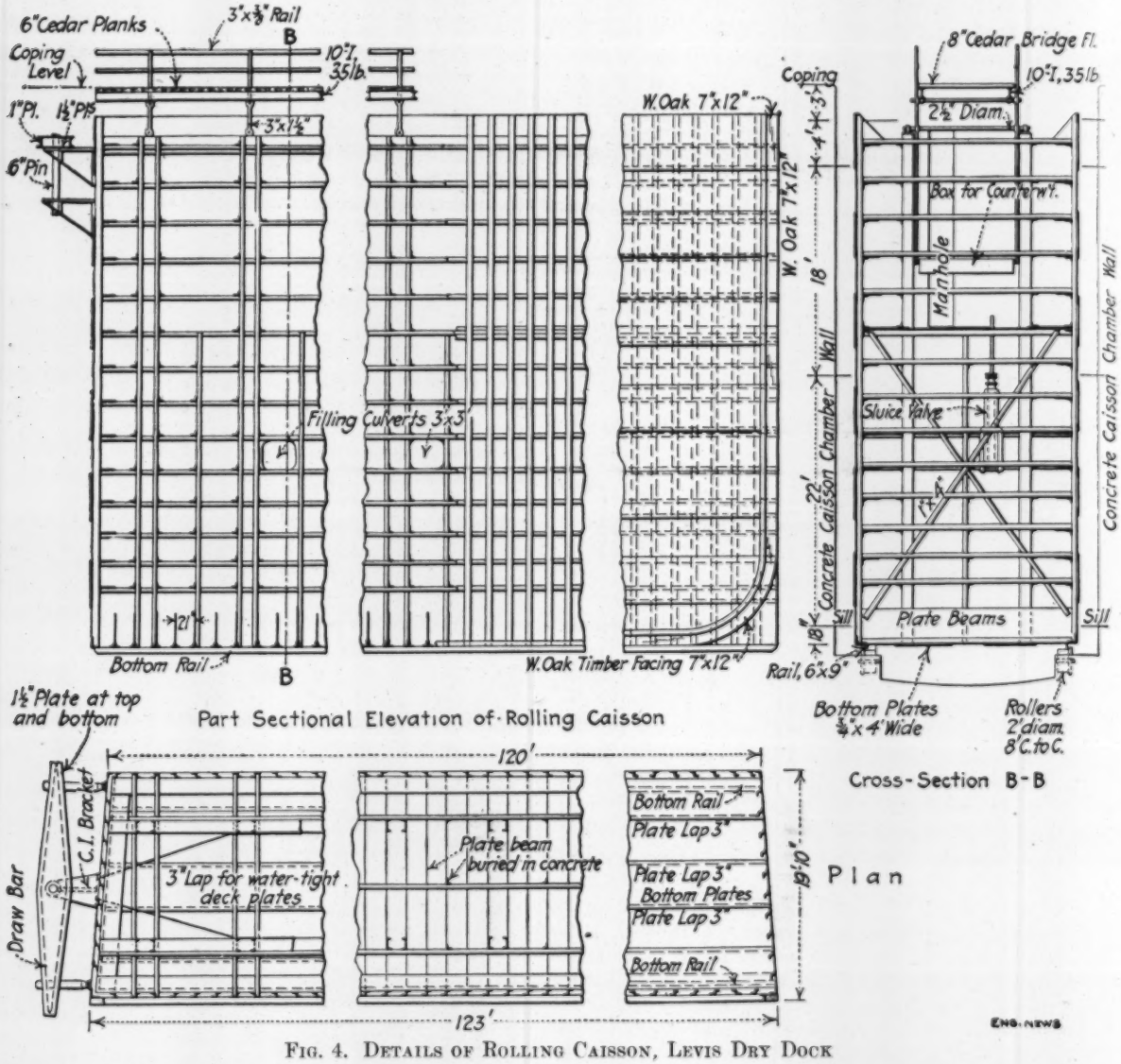


FIG. 4. DETAILS OF ROLLING CAISSON, LEVIS DRY DOCK

walls. As shown also on the drawings, four timber slides with adjoining stairs are to be built at right angles with the sidewalls. The sliding faces of the timber slides are to be built of granite 18 in. thick and not less than 4x3 ft. 6 in. in plan.

CAISSON GATES

The outer entrance is to be closed with a rolling caisson of generally rectangular section 123 ft. long and 19 ft. 11 in. wide, as shown in Fig. 4. This is in effect a hollow steel frame box so ballasted as to float evenly in water. When not in use it is kept in the caisson chamber in section, are to be built through the width of the caisson to be used in filling the dock.

The bottom rails, which transfer the weight of the caisson to the rollers on which it is pulled across the opening, are to be made of medium hard steel that will bear the whole weight of the caisson and ballast without deflection at times when the caisson is undergoing repairs and there is no hydrostatic pressure underneath. The bearing face on the inner side of the caisson is to be timbers fitted in angle irons, and the caisson chamber is to be covered with 4-in. white pine, resting on steel I-beams 30 in. c. to c. set in the concrete wall.

When the dock is not in operation during winter (for Quebec is a closed winter port) tidewater will be prevented from coming over the deck by closing the valves. The lower part of the caisson under the dock will then be filled to counterbalance the flotation. A 1½-in. steam pipe is to be placed at the bottom of the caisson to carry steam to the water and prevent it from freezing during the winter, and a similar pipe is to keep free the joints between caisson and chamber.

The floating caisson is to be used to close the inner entrance and in times of emergency the outer entrance, as shown in Fig. 5. It is of the boat-hull section generally used for such floating gates. It is to be built also of mild steel to sustain the same head of water as the outer caisson; that is, 45 ft. It has water-tight ballast, air and tide chambers, and will contain sufficient ballast to be easily handled when afloat. Six filling culverts, each of a sectional area of approximately 10 sq.ft., are put through the lower part of the caisson and provided with suitable valves to be worked with electric motors placed in position to be manned from the upper deck. Two centrifugal pumps with bronze impellers, each of a capacity of 5000 gal. per min. against a head of 40 ft., are to be installed in a suitable position to remove the water ballast from the scuttling tanks. The top deck is to be 15 ft. wide and will serve as a bridge across the dock. This gate is provided with timber sills and sides which butt against the sills and vertical walls built into the concrete sidewalls at the midjoint, thus forming a water-tight barrier there. When the full length of the dock is to be utilized, the floating caisson is towed outside of the dock.

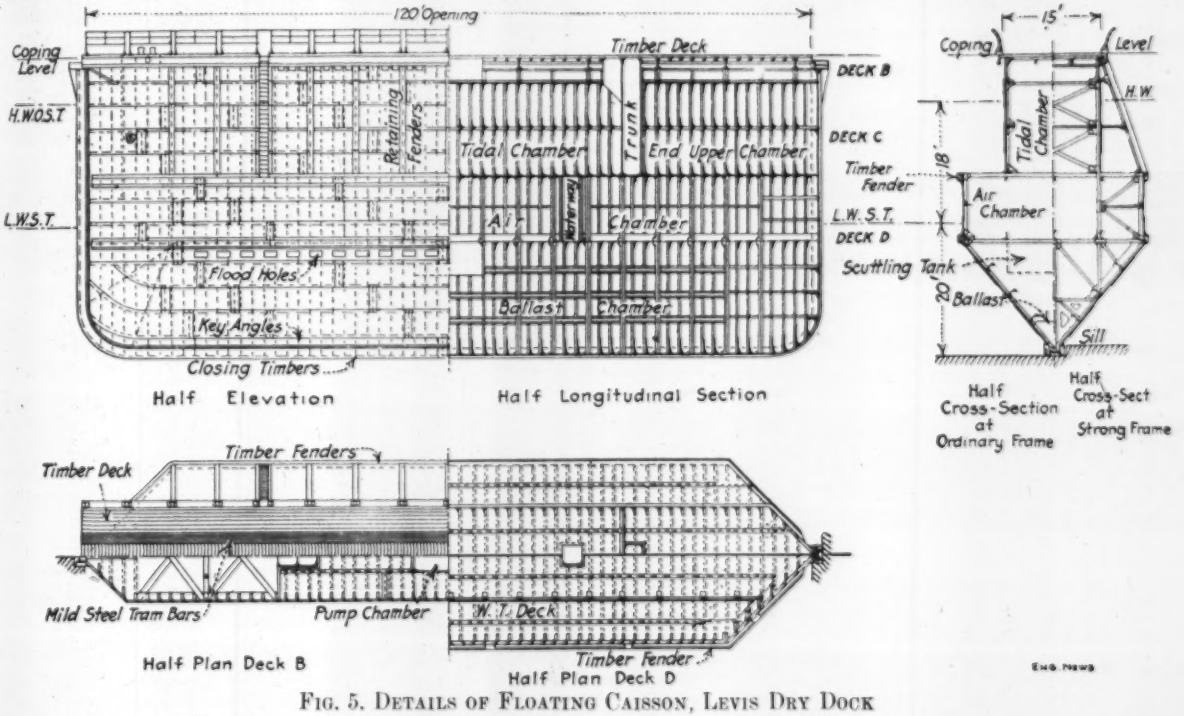


FIG. 5. DETAILS OF FLOATING CAISSON, LEVIS DRY DOCK

CULVERTS

The filling and emptying culverts, shown on Fig. 2, are so arranged that each part of the dry dock may be independently filled or emptied, although the rear chamber cannot be filled without first filling the front chamber. The filling culverts take in water in the entrance and lead it into the front part of the chamber around the rolling caisson. The rear chamber is filled through a culvert curving around the mid-caisson. The emptying culvert for the rear chamber takes out from a sump near the floating caisson sill and is carried through one sidewall (see section in Fig. 2) to the pump house. The front chamber is emptied through a culvert running from the sump directly through the wall to the pump house.

PUMPS

The specifications for the pump and driving engines are in part as follows:

The contractor shall furnish and set in place on suitable foundations and at the required elevation, six wrought-steel water-tube boilers each of sufficient capacity to furnish 500 hp. and two boilers of 300 hp. each, working under steam pressure of 200 lb., set in batteries of two boilers each. Each boiler may be built with two or more drums not exceeding 48 in.

The boiler should show an efficiency of 75% when fired with good coal containing 12,500 b.t.u. or over per pound.

GENERATORS—There shall be three direct-current generators, 550 volts, one of 1500 kw., one of 750 kw. and one of 300 kw., each driven by steam turbines of the Westinghouse-Parson type, or by triple-expansion reciprocating vertical engines capable of developing 25% overload. These generators shall be built so as to allow the connections in multiple when required. A lighting direct-current generator shall also be installed of 100 kw. 220 volts to be driven by a vertical direct-connected compound engine mounted on same bed plate.

MOTORS—The contractor shall furnish and install the following direct-current motors: three motors of 1000 hp. each for the main pumps, 550 volts of suitable speed for pumps; two motors of 125 hp., 550 volts for the auxiliary drain pumps and of suitable speed; one motor of 125 hp., 550 volts geared to worm operating the rolling caisson, speed, about 300 r.p.m. and reversible; one motor on rolling caisson, 15 hp., 550 volts, with shaft extending on both sides and each end carrying three pinions and beveled gear to operate the six caisson valves; four motors of 15 hp. each 500 volts, provided with pinions and beveled gear to operate the main culvert valves; two motors of 100 hp. each on the floating caisson to operate the pump thereon; one motor of 10 hp. with pinions and beveled gear, fitted as specified for the motor on

the rolling caisson to operate the sluice valves in the floating caisson. If required so to do, the contractor shall also install motors to operate any of the capstans to be placed on each side of the dock, in which case the motors shall be so installed as to be protected from dampness and rain and made detachable from their foundation.

PUMPS—The contractor shall furnish and install the undermentioned centrifugal pumps for the dock equipment, three main pumps of the vertical type to be placed in the pump house each having a capacity of 60,000 Imp. gal per minute, with suction and discharge pipe 58 in. diameter; the suction pipe to be provided with a bell-shape extension; it shall be supported by angle irons riveted on the outside and fitted in the concrete floor of the pump house, the discharge pipe being solidly fitted in the wall of the non-return valve chamber.

These pumps to have cast-iron impellers, bronze shaft and cast-iron casing with two suitable bearings provided with forced oiling device and the shaft connected to the motors with flanges, all of which to be provided by the contractor and installed in perfect working order. These pumps shall show an efficiency of 72% when working against a head of 25 ft.

The contractor shall furnish and place in the pump house two drain centrifugal pumps of the vertical type with 18-in. suction and discharge pipes. The suction shall be provided with a bell-shape extension and foot valve; proper means shall also be provided to charge the pumps. These shall have cast-iron impellers fitted on bronze shafts which shall be flange connected to the motor shaft. The discharge pipes shall be supported on bracket fastened to the walls of the pump house and carried to the main emptying culvert of the dock. A sluice valve shall be provided in the discharge pipe for closing same.

These pumps are intended to work against a head of approximately 40 ft. and shall show an efficiency of 70% when working against that head.

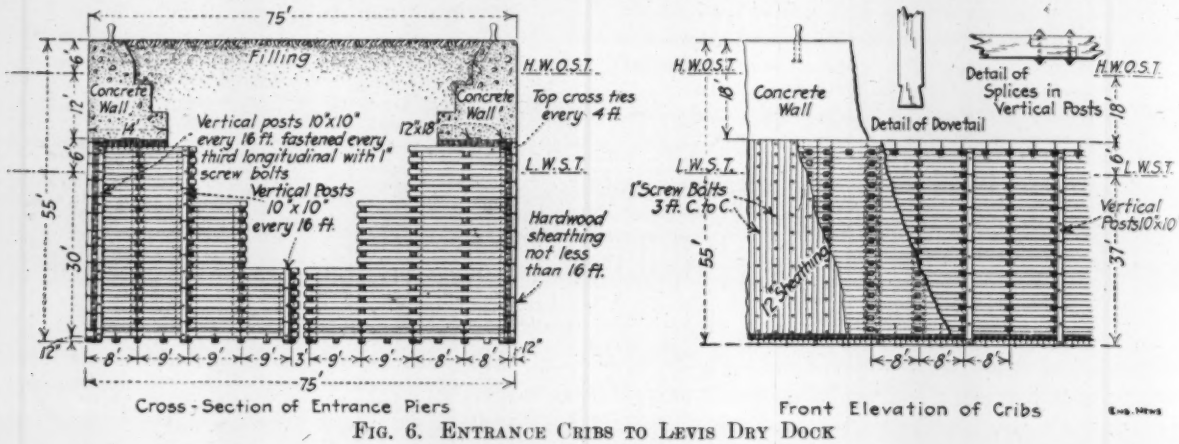


FIG. 6. ENTRANCE CRIBS TO LÆVIS DRY DOCK

THE ENTRANCE WALLS—The walls at the entrance, shown in Fig. 6, are to be built of timber cribs filled with riprap and carrying on their top a mass concrete gravity wall. The walls are each 75 ft. wide and 600 ft. long, spreading to give an entrance width of 300 ft. In construction they are to be built according to the general plan used in building breakwaters of this type; that is, a stone foundation will be laid on the earth bottom for the full length and width of the work, each stone to be about 1 cu.ft. in size. This is to be laid for a depth of 4 ft. and to be covered with 12 in. of smaller stone to fit the voids. On top of this the timber is to be laid to an elevation of 6 ft. above low water and is to be entirely filled with stone on the under side of the timber floor which carries the concrete superstructure. The space between the concrete walls is then to be filled in with earth.

BLOCKS—For supporting the vessels in the dry dock both keel blocks and bilge blocks are to be used. These are shown in Fig. 3. The keel blocks are portable and rest on the granite blocks at the crown of the floor. Each block is composed of three hollow castings copped with timber blocks held as shown in the cut.

The bilge blocks are of pine blocks cut to the shape shown; they rest on bilge block slides which are built in the floor. These are placed every 16 ft. transverse of the dock. They are oak blocks, 3 in. thick and 12 in. wide and are secured to the bottom by anchor bolts. These bilge blocks are provided with slide irons and attachments to chains, which chains are connected to blocks fastened to the sidewalls so that the bilge blocks may be moved.

MATERIAL

The dock walls and floor approach walls, culverts, pump wells, sumps and the superstructure to the wharf and bulkhead are to be built of concrete, occasionally reinforced as noted on the drawings. This concrete is to be composed of portland cement made in Canada, crushed stone 2½-in. size, washed gravel and sand. Two classes of concrete are to be used. Class 1 consists of 1:2:4 mixture and Class 2 of 1:3:5. The 1:3:5 is as a rule used for the mass work and is to be surfaced in general by a 12-in. thickness of the 1:2:4 concrete. Except for the granite blocks shown on the caps and copings, no protection of the concrete against sea water or ice is to be applied.

PERSONNEL

The dry dock has been designed and will be constructed by the Department of Public Works of the Dominion of Canada, of which Eugene D. Lafleur is chief engineer. E. A. Hoare is in charge of the construction and the contract has been let to M. P. and J. T. Davis, of Quebec.

The Preparation of Engineering Reports*

BY EDWARD BEATTIE STEPHENSON†

An essential part of the work of an engineer consists in making a formal report on some project under consideration. This may be only a short record in a notebook or it may be a report on a technical investigation of some great project like the Panama canal. In any case it must include

*Abstract from "The Quarterly Journal of the University of North Dakota," October, 1913.

†Assistant Professor of Physics, University of North Dakota, University P. O., N. D.

a certain amount of data with description, and the availability of this information depends to a large extent on the manner and form in which it is presented. Now skill in writing a report is no more an inherent faculty than is skill in integrating a differential equation. It is an acquired art. Too many reports are like a low-grade ore, the amount of valuable material finally obtained does not pay for the labor necessary to extract it.

Viewed solely from the efficiency standpoint it pays to have the writer put considerable time and study on the composition of his report. Suppose the operating manager of a railroad requires a report on the maximum tonnage for a given type of engine. This report is to be sent to 100 men who make up the trains at the different yards and who are to be guided by the facts found in the report. If the presentation of the report in one form rather than in another will save each reader five minutes in the time necessary to master it, it is a saving to the railroad to have the writer spend an extra eight-hour day in working the report into the better form.

And when we consider the fact that an article on an important subject in a technical journal may have thousands of readers, it is really quite morally reprehensible for a conservationist, such as every engineer should be, to waste the reader's time when more care and attention on the part of the writer would have made such waste unnecessary. To determine what this better form is requires a technical knowledge of the subject of composition and also a mastery of the subject matter and practice in actually presenting it.

The character of an engineering report must, in general, be determined by a consideration of the persons to whom the report is to be made. The business man who consults an engineer in regard to some project desires an authoritative opinion on a technical matter which only an expert can understand. The detailed facts and the method of reasoning by which the conclusions are reached are of minor importance. A report to him must be in reasonably non-technical language with such facts and arguments as will appeal to his common sense and general type of mind. To say that a perpetual motion-machine is impossible because it would violate the second law of thermodynamics is a perfectly satisfactory statement to a physicist but it would hardly appeal to the man on the street.

On the other hand when a chief engineer requests a report from an assistant, he wants carefully prepared and analyzed data and is fundamentally interested in the methods of investigation and detailed facts obtained, for on these he wishes to form his own expert opinion.

What then are the essential qualities of an engineering report? First, it should consist of a large proportion of experimental facts. Second, these facts should be carefully analyzed and conveniently presented. Third, there should be more or less elaborate discussion of the theory involved in the work and of the conclusions to be drawn from the facts presented. Fourth, the style of composition should be direct and forceful with no attempt at fine writing. Glittering generalities should be eliminated as prima facie evidence of a lack of exact knowledge and each sentence should be carefully inspected for superfluous words.

INTRODUCTION

The introduction to a report should contain a concise statement of the object of the investigation with any necessary explanation of the reason for undertaking it, and with some reference to previous work in the same line or any special conditions that may exist. The reader should be able to decide from the introduction whether or not he cares to read the whole article or book.

DESCRIPTION

Nearly every report requires a certain amount of descriptive matter—description of apparatus, object tested or work constructed—and the dominant idea should be to give the reader as comprehensive a grasp of the subject as possible in the easiest and quickest way. The present tendency is away from long pages of written description and toward a greater use of diagrammatic drawings, free-hand sketches and photographs. A diagrammatic drawing of good proportion and freely lettered is generally better than a page of description. It is useful for a comprehensive view of the whole and at the same time permits a close study of any particular point without having to go through the whole description.

The written part of the description is simplified by references to the drawings and photographs, and detailed dimensions, etc., should generally be given on the drawings and not written out unless some legal requirement makes it necessary. The description should follow some definite order, possibly that in which the apparatus functions or in which the work was constructed, and in it such technical terms as will be used later should be defined.

METHODS OF INVESTIGATION

The experimental method by which a theoretical point is to be tested is always more or less independent of the theory and this should be kept in mind when writing the report.

In using methods or theory that are not strictly original the writer should give full reference to the original sources unless the information is common knowledge.

If the investigation covers a number of different lines it is advisable to separate them under distinct headings for clearness of presentation. It also frequently happens that a reader is interested in only one phase of the subject and this separation enables him to follow that phase in detail without having to read the whole report.

DATA

From the scientific point of view the original data are by far the most valuable and should always be carefully preserved, but for a formal report the limitations of time and space frequently necessitate some generalization or derived results. The presentation of data in their most available form is a problem worthy of very hard study.

The plotting of data in the form of curves is a very common method to the scientist but in non-technical writing it seems to be almost unknown. Considerable experience has shown too, that it takes a year's hard drilling to teach the average sophomore to plot his data intelligently with a proper choice of coördinate scale and with some regard for the usual conventions.

The curve is also useful as a means of averaging data, as an indication of the accuracy of readings, as a suggestion of the general law governing the relation of the variables and for calling attention to particular points that may require closer investigation, but its most important function is to give at one glance the whole course of the related phenomena, thus reducing the written description to comment on the most interesting features.

Another point which should always be covered in an engineering report is the accuracy with which the experimental work is done. Accuracy is purely a relative matter and the engineer must learn to judge how accurately his work should be done. In leveling for the foundation of a shed a few inches off level would not be a serious matter but in setting a large telescope, one hundredth of an inch variation might be inadmissible. Work should therefore be done with an accuracy that is determined by the conditions or object of the work. There are certain standards and conventions that should be understood in this connection. In writing a number there is a well established convention that as many, but no more, significant figures should be given than the writer claims the accuracy of his data warrants. Thus writing the radius of a circle as 10 cm. means that 10 is the nearest whole number and that the exact value may lie between 9.6 cm. and 10.4 cm. If, however, the number is given as 10.0 the second cipher has the meaning that the measurement was made to tenths of a cm. and lies between 9.96 and 10.04 cm. There is a possible error in the first case of 5% and in the second case of 0.5%. The location of the decimal point is merely an indication of the units used and not of the percentage accuracy. Thus the numbers 12.3 cm., 123 mm., 0.000123 km. all have the same number of significant figures and the same percentage accuracy although the last one is carried to six places of decimals. In physical measurements we must discard the mathematical idea of absolute accuracy and learn that any measurement is only an approximation, that it takes careful work to get four significant figures and that six or seven figures are obtained only in a standardization laboratory. The ciphers before a number serve only to locate the decimal point and are not significant figures, but ciphers after the number are significant and indicate its accuracy.

Another important point is, that as a chain is no stronger than its weakest link, so a calculated result is no better than the last accurate factor or term in the calculation. For instance, in calculating the circumference of a circle whose radius is measured as 10 cm. it is quite absurd to use $\pi = 3.1416$ because the possible 5% error in the measurement of the radius, as shown above, is so large that $\pi = 3^1/_7$ or $\pi = 3.1$ is as accurate as the measurement of the radius. A large per cent. of the labor of numerical calculation is absolutely wasted because of this lack of a proper knowledge of when to drop the figures that have no significance, and the appearance of accuracy that the retention of all the figures gives is misleading.

CONCLUSIONS

The conclusions should be grouped under a few main points and should be as brief and clear cut as is consistent with accuracy. In case of a long report it may be advisable briefly to summarize the evidence on which each conclusion is based with page references to the details.

The Reconstruction of Mahanoy Plane, Philadelphia & Reading Ry. Co.

By Joseph S. Ward*

Incidental to a description of the extensive improvements recently completed by the Philadelphia & Reading Ry. Co. to its inclined plane at Frackville, Penn., eight miles north of Pottsville, some account of the early railroads of the State, of which the Reading system in the anthracite region has been the gradual evolution and development, may be of interest.

Such a history, with a statement of the conditions under which the planes in which these lines abounded were originally built nearly a century ago, will not only give a better understanding of the reasons which have dictated the continuance at Mahanoy Plane of a method of transportation generally looked upon as obsolete, but will also provide a fitting introduction to this paper.

Early Railroads

The first tram or railway, of record in North America, appears to have been at Quincy, Mass., where a line three miles in length, built in 1826, was extended in 1828 the same distance to Milton Landing on the Neponset River and was used to transport stone for the Bunker Hill monument.

The grade of this track was descending from the quarries to the wharf, a load of 40 tons of stone was hauled thereon by two horses and blocks weighing as much as 64 tons each were not infrequently handled. Its gage was 5 ft. and the rails, of strap iron, were fastened to longitudinal pine stringers resting on transverse granite blocks spaced 8 ft. between bearings. The line was operated by horses only, until 1871, when the Old Colony R.R. Co. purchased it, demolished the track and replaced it with a modern railroad.

Notwithstanding the existence at Boston, in 1807, of a similar shorter line on the western slope of Beacon Hill, and of another in 1810, near Chester, Penn., from the quarries of Thomas Leiper to Crum Creek and, although the character and construction of this "Granite Railway" at Quincy hardly entitled it to such preëminence, its frequent mention as "the first American Railroad" has given to the Bay State the distinction of being the pioneer in railway building in this country.

Pennsylvania, however, may claim credit not only for the *next American tramway,* but for such a manifestation of energy in the earliest days of railway construction as surpassed the united efforts put forth by the rest of the United States in this direction.

The second American railway was constructed in 1827 by the Nesquehoning R.R. Co., from Mauch Chunk to the Lehigh River, a distance of nine miles, and was used to convey coal from the mines to boats. The loaded cars descended the steep inclines of this railroad by gravity and when empty, were returned to the collieries by mules; later on, stationary engines and cables were substituted for this primitive method of operation. The track was similar to that of the Quincy tram, wooden cross-ties, however, being employed in place of the transverse granite blocks.

During the years immediately following the completion of these planes, Pennsylvania was well in the lead of other states in railway construction and, at the close of 1833, had 265 miles open for traffic out of a total mileage in the whole United States of 1098. This growth, remarkable for the period, is attributable to the contemporaneous development of the anthracite coal lands. Although hard coal had been mined as early as 1820, it did not come into general use during the following decade while it was passing through the experimental stage; and in 1820 but 365 tons had found their way to market from the Lehigh region.

The Skuylkill Canal was completed in 1825 and 6500 tons of coal were marketed in that year. The increase in the trade was so rapid from this time on that in 1840, upward of 500,000 tons were shipped from the Schuylkill region alone. This extraordinary expansion of the coal industry, the growing demand for fuel for manufacturing purposes in Pennsylvania and the magnitude and value of the rapidly increasing miscellaneous tonnage explain fully why the Keystone State made such strides in covering its surface with a network of railroads, which became more complex and numerous with each succeeding year, and early ranked as the greatest railroad state in the Union.

Nearly all these early railway lines were built to carry coal exclusively, from the regions now tributary to the Reading Co.; they were of the most primitive character, operated by mules and horses, and so located as to involve a minimum cost for grading. They penetrated the numerous local basins of the "Middle" and "Southern" anthracite fields and followed the most direct, feasible routes between the mine openings and the points of shipment by water at the canal landings.

Inclined Planes

No more general application of the principle of the inclined plane in connection with railway transportation has probably ever been made than prevailed at this time over the districts covered by these early lines in Pennsylvania. Great canals could not cross the mountains; it had not yet been shown that railways could; and the higher ascents were logically and usually overcome by inclines, operated either by gravity or by stationary engines.

The most notable examples of the use of these planes were by the Nesquehoning R.R. as mentioned, the Philadelphia & Columbia R.R., at Belmont, near Philadelphia, the Portage R.R. over the Alleghanies between Hollidaysburg and Johnstown, the Delaware & Hudson Canal and R.R. Co. from Honesdale to Carbondale, the Lehigh & Susquehanna R.R. at Ashley, near Scranton, the Mine Hill & Schuylkill R.R., at Ashland and Gordon in Schuylkill County, and by the Mahanoy & Broad Mountain R.R., in the same county, at the point between the boroughs of Gilberton and Frackville from which the subject of this article takes its name.

Excluding the operations of the Columbia & Portage R.R., these planes were used for coal traffic only and, with the exception of those at Mauch Chunk, Ashley and Gilberton, they were all long ago abandoned. The Ashley planes are still maintained by the Central R.R. of New Jersey for the hoisting of its loaded cars only; over Mahanoy Plane, the Reading Co. continues to handle the empty and loaded cars reuired for an approximate annual output of 6,000,000 to 8,000,000 tons;

*Resident Engineer, Philadelphia & Reading Ry., Williamsport, Penn.

and the famous "Switchback" at Mauch Chunk is well known to tourists, for whose pleasure only it has been maintained for many years.

The Danville & Pottsville R.R., incorporated in 1828, by Stephen Girard, of Philadelphia, General Daniel Montgomery, of Danville, and others, and by which it was proposed to furnish a short and favorable channel to market for the trade of both branches of the Susquehanna through connection with the water-ways then existent, contemplated the construction of 16 planes.

Two portions only of this railway were completed, the western one of which now constitutes the Shamokin Branch of the Pennsylvania R.R., the other being occupied by the public highway between Frackville and St. Clair. This part of the line, still referred to as the "Girard" road, was operated and carried coal for a time from collieries in the Mahanoy Valley to Port Carbon, and a very interesting account of an excursion over this route in 1833 appeared in the Pottsville *Miners' Journal* of that year.

Between these termini six planes were in operation, four of the "self-acting" type (by which empty ascending cars are hoisted by descending loads), between Port Carbon and Frackville, one of the same character between Montgomery (now Gilberton) and Girardville, and one along the southern slope of Broad Mountain between Frackville and the Mahanoy Valley, which was operated by steam. This sixth plane occupied a position just south of the present Mahanoy Plane of which it was the precursor and is described as having a length of 1625 ft., a height of 345 ft. or, the greatest length and altitude of the 16 proposed. The stationary engine by which it was operated was built by a mechanical engineer in Pottsville, of the Snyder family, which has given so many distinguished engineers to the state and several well known members of which are still active in the profession in the coal regions and elsewhere.

The first carload of coal to pass over the plane was hauled by teams from the colliery of James J. Connor (now known as the "Hammond"), near Girardville, to the railroad at a point near the present Girardville Station. It was shipped on May 30, 1862, to the Mayor of the City of Philadelphia, who presented it to the Volunteer Refreshment Saloon in that city.

Development of Mines and Railways

The entrance of the Philadelphia & Reading R.R. into the "Southern" anthracite field in 1842 gave even greater stimulus to both the mining and railroad industries. After its completion to Pottsville in that year, the constructions and extensions of lateral lines were so active and comprehensive that the areas of both fields were practically covered within the next decade, at the expiration of which the annual anthracite output from the Schuylkill region had reached 2,650,000 tons.

The character of these coal roads was rapidly bettered, steel rails of approved form replaced the wooden stringers and strap-iron lines, locomotives were substituted for animal motive power, road beds were widened and strengthened, connections were made to the Reading tracks and traffic through the canals rapidly diminished.

The Philadelphia & Reading Co., which had fostered and encouraged these improvements, gradually instituted and developed a policy of acquisition and consolidation by which, in 1870, it finally secured control of and had merged the lateral railways of both fields. The simultaneous closing of the Schuylkill Canal placed the business under the domination of the Reading Co. and gave to it an annual coal traffic of 5,000,000 tons volume.

For the first twenty years of active production in the Schuylkill region there had been very little coal mined or shipped from the "Western Middle" field, the comparatively small production of which found its way to market westward to the Susquehanna River at Sunbury and Port Trevorton, and thence by the Susquehanna Canal to the Chesapeake.

During this period, the tonnage from the "Southern" field, the most advantageously located with reference to tidewater and one of the first basins to be developed, exceeded that of any of the other anthracite divisions. As it became known that the beds of the other districts generally contained less refuse and were more reliable, its relative output grew less, it now stands at the foot of the column and the more prolific "Western Middle" field has taken its place.

The exhaustion of the more cheaply mined coals in the other basins will no doubt in time place the "Southern" field, by reason of its great extent and enormous coal content, once more in the front rank. A tendency in that direction is already manifested by the activities of the P. & R. C. & I. Co. at several points in the valleys of the West Branch of the Schuylkill River and its tributaries.

In 1855, the Mine Hill & Schuylkill Haven R.R. completed its Ashland extension by which it gained access to the important, valuable and more easily worked beds lying north and west of the Schuylkill Basin, to accomplish which it had constructed the two planes at Gordon having an aggregate length of nearly two miles and by which the crest of Broad Mountain was crossed with a total lift of 717 ft.

In 1862, the Mahanoy & Broad Mountain R.R. abandoned the contemplated utilization of the old "Girard" grade and under the direction of George B. Roberts as chief engineer, finished the building of an extension from St Clair to Frackville and of a new plane on the south side of the Broad Mountain, the material features of which did not greatly differ from, and still appear in those of the reconstructed plant the description of which is to follow.

The almost complete severance of the pioneer lines in the "Southern" field from active connection with the canals, consequent upon this railway expansion, had resulted in the establishment, south of the mountain, of yards for weighing, classification and distribution, the sites of which followed those of the principal canal landings at Schuylkill Haven and Port Carbon; and the Cressona Yards near the former point and the St. Clair plant at the latter, had become concentration points for the coal originating in the western and eastern ends of the field, respectively.

These yard locations, the fact that a low-grade route from the Mahanoy Valley to tide water was not furnished until 1864 by the piercing of Broad Mountain with a tunnel, and the shorter and more direct connections between the two fields by way of Gordon and Frackville are the factors which influenced the maintenance of the planes at both points until 1899, when the Gordon Planes were abandoned.

Mahanoy Plane, 1870-1910

From that time until the present, the entire coal product of the Shamokin and Mahanoy Valleys (with the exception of small shipments westward to the Great Lakes and from the Tamaqua region eastward by way of Port Clinton) has found its way to market over the Mahanoy Plane, the sole survivor of the old method of mountain climbing and by which 60% of the Reading coal trade, approximating 300,000,000 tons, has been safely and expeditiously transported during the last 50 years, the high-water mark of 10,000,000 tons annual output attained in 1883, having been practically maintained ever since.

Under Reading ownership, improvements to the planes at Gordon and Frackville were made from time to time by the substitution of heavier rails, the installation of cables of increasing diameter and in amplified and improved boiler service; but no radical or important alterations were made until 1884, when the engine and boiler plants at Mahanoy Plane were rebuilt and the old plane capacity of 700 tons hourly was almost doubled. The engines which at this time replaced those from the shops of George W. Snyder, of Pottsville, brother of the builder of the Girard engine, were designed and constructed at the shops of the Philadelphia & Reading Coal & Iron Co. in the same town.

With occasional changes and additions—the most important of which were the substitution a few years ago of automatic stokers and tubular boilers for those of the hand-fired cylindrical type—Mahanoy Plane continued to do yeoman service, but became so severely taxed by the constantly increasing weight of cars and the growing business as to demand its almost incessant operation, and made inevitable the reconstruction decided upon about three years ago.

The details of plant location and method of operating at Mahanoy Plane, prior to this time, did not vary greatly from that installed in 1862 or 1884 and may be briefly described as follows: The double-track road bed ascended the southern slope of Broad Mountain from the "Foot" in the Borough of Gilberton to the "Head" at Frackville, without heavy grading. The difference in elevation between the rails over the "barney" pits and those at the summit was almost exactly 365 ft. in a distance of 2470 ft.; and, the profile, generally parabolic, ended with a maximum straight grade approaching the summit of 22.02%, or a pitch of 12° 25′. A vertical curve 100 ft. in length connected this grade with that leading from the "Knuckle" and having a rate of 0.3% for a distance of 125 ft. to the frog separating the loaded and empty cars at the "Head."

The spacing between centers of tracks increased gradually from 11 ft. at the "barney" pits to 12 ft. 6 in. at the crest. Each track was laid with double lines of rails the outer ones of which carried the standard-gage loaded and empty cars. The inner rails, having a gage of 3½ ft. were for the trucks or, as they are locally termed, the "barneys," against which the cars rested as they were lowered or hoisted over the plane. These barney rails, which ended at the summit a short distance beyond the knuckle, terminated at the Foot in pits, which received the safety trucks as they left and were overrun by the empty yards, and from which the barneys were in turn pulled against the loaded cars at the time of initial hoist.

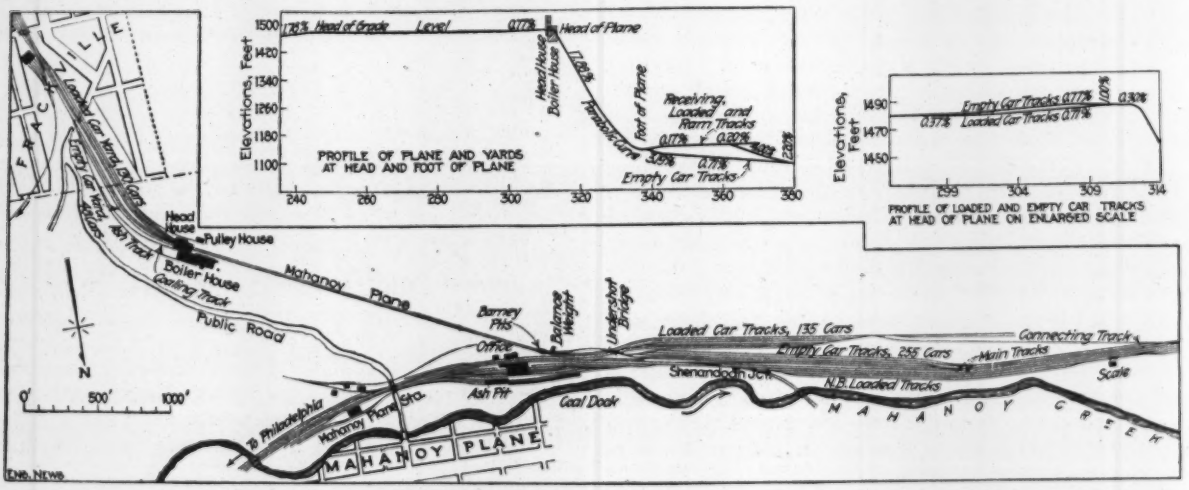


Fig. 1. General Plan of Mahanoy Plane, at Frackville, Penn., Philadelphia & Reading Ry., with Yards at Head and Foot of Plane, June, 1912

The tracks at the Head, immediately beyond the knuckle, were covered by a Head House, the roof trusses and skeleton frame of which were of metal, sheathed with corrugated iron, and were so equipped with turnouts and a diamond crossing that each of the plane tracks had connection with both the loaded and empty yards at the Head. This permitted the alternate lowering and hoisting of loaded and empty cars on both plane tracks.

The dimensions of the old Head House were 50x100 ft., the track floor was of waterproof metal construction and constituted the top covering of the engine room, 30x70 ft., located immediately beneath with a floor level 15 ft. below the rail. This floor intersected the natural ground line of the mountain slope on which the buildings were located and in consequence, the excavation for the engine room, west of this line of intersection, had been in the solid top rock of the region, permitting ventilation and illumination through window and door openings in the northern wall only. The other walls served to define the engine room limits, to retain the adjacent rock

and roadbed and to support the track substructure and Head House.

In the northwest corner of the Head House and overlooking the plane, a small frame annex, protected by corrugated-iron covering, contained rooms for car runners, checkers and the levers operated by the plane engineers; stairways led to the engine room below.

Parallel with the engine room to the north, was located the boiler house 50x148 ft., the floor of which was 22 ft. below that of the engine room. Its walls, of mountain stone, were covered with a slate roof on timber trusses and the floors were concrete. Between the boiler and engine house and parallel thereto, a wooden coal trestle and bins had been established for boiler-house storage and supply.

The grades of the yards at the Foot and Head were so arranged that descending empty and ascending loaded cars left the barneys at the summit and foot, respectively, by gravity, brakemen at each point catching them as they passed and riding them until they were safely stopped at the desired points.

The loaded cars at the Foot and the light cars at the Head were pushed by ram engines over humps, at comparatively short distances from the barneys against which they were dropped by gravity in either direction, for ascent or descent.

One of the most interesting features of the plant was the manner in which the boiler fires were fed and maintained and by which the ashes were removed; but, as the same admirably simple and economical system also prevails at the new plant, its description will be given later as will that of the hoisting details.

FIG. 2. VIEW LOOKING UP MAHANOY PLANE FROM THE FOOT

FIG. 3. VIEW FROM HEAD OF MAHANOY PLANE, SHOWING ASCENDING AND DESCENDING TRIPS NEAR CENTER

MAHANOY PLANE RECONSTRUCTION, 1910-1912

The work of revision, determined upon in 1909 in connection with the enlargement of the St. Clair Yards which had already been begun and, an account of which appeared in ENGINEERING NEWS, of Sept. 18, 1913, was started in April, 1910. The work, proposed and accomplished, included an enlargement of the boiler plant and house, new and more powerful engines, better and more commodius head house, oil house and ash bins, a rectification of the plane grade and more adequate yard facilities at both the Head and Foot. The profile adjustment by which the maximum ascent has been reduced from 22.02% to 17.88%, or to a new pitch of 10° 8′, involved a lowering of the plane knuckle about 28 ft., the establishment of a new summit 100 ft. farther east, the consequent demolition of the old head house and engine room and the filling in of the latter. By this grade rectification the plane length has been increased 130 ft. and its elevation lowered 2.12 ft.

Through the old yards at the Head, traffic had continued to be governed by the Continental, "keep to the left," rule of the road which prevailed during the days of their first construction. As this was in conflict with traffic operation immediately south of the plane summit and elsewhere on the Reading System, and produced uncalled for in and out cross-over movements, such elevation of the loaded tracks and depression of the empty yards as would secure proper plane working grades and correct these long existing defects, were carried out. This necessitated a large amount of additional grading as well as the construction, along the south side of the loaded tracks, of a long retaining wall to support the adjacent high ground and dwellings thereon. An 18-ft. arch, over the public road at the eastern end of the yards, was also extended 20 ft.

In planning the engine foundations and to overcome the difficulties previously experienced in removing and replacing engine anchor bolts which had been broken, the massive masonry base upon which the new engines rest was placed in a basement beneath the engine room, giving foundation depth 31 ft. below the new track floor and only 6 ft. higher than the boiler settings.

As ashpits in the boiler room are from 7 to 12 ft. below its floor, as all grading has been in the hard conglomerate and slate of the region, and as the work was conducted under incessant traffic, the difficulty and magnitude of the excavations may be readily perceived. The bulk of the materials removed were taken out and away by carts, from the north, at points of lowest elevation, the balance by derricks at the Head level. Grading for the boiler-house extension and lower half of the new

engine room was started simultaneously; building walls and boiler foundations were begun and proceeded with as excavations were made and work at both sites was prosecuted continuously and at the same time.

All buildings and other walls were constructed of the excavated rock; copings, foundations, bearings, lintels, sills, ash-bin roof and floors are of concrete, for which stone from the several openings was crushed on the ground.

The grading necessary to interchange of elevation at the empty and loaded yards was carried on contemporaneously with other grading operations. Proper track alterations having been made to clear the area, blasting and digging for the lower half of the engine room were started in April; this excavation was finished in November, 1910; the temporary trestle supporting tracks over the opening and between the yards and the knuckle was then built; and, the remaining upper half of the engine-room excavation was rapidly pushed and completed in March, 1911.

As excavation for the engine room proceeded, its walls were advanced, those of the boiler house, ash bin and oil houses going on simultaneously although much faster, as by this time the grading necessary for their erection had been completed. By May, 1911, the stone masonry walls of the engine, boiler, ash and oil houses, as well as the lower concrete floors in these buildings had been practically completed; the forms for the engine beds, larger sheave foundations and the north engine-room wall were started in the middle of June; and, by the end of July, these concrete structures were ready for the machinery and steel.

In August of the same year, the additional boilers and stacks were in position and the structural steel of the several buildings, the placement of which had been begun in the same month, had all been erected early in November. During the last two months of 1911, the working force was employed almost exclusively upon the interiors of buildings and the completion of grading and tracks at the Head.

Early in January, 1912, this building and track work were so far advanced that construction gangs were reduced 75%. The small number of men employed was kept at unfinished minor items including the ash hoist, which was put in operation in February, until April, 1912, when less than 10% of the construction work beyond the "Knuckle" remained to be done.

Taking advantage of the suspension of mining which occurred at that time, the contemplated plane-grade revision was started on Apr. 1, when the original normal force of labor was largely increased. The excavation at the summit was pushed so rapidly that by June 1, 1912, it was entirely completed, the tracks over the new grade had been laid in their correct positions, and the knuckle sheaves and cables were ready for preliminary hoisting at about the time the collieries again started up.

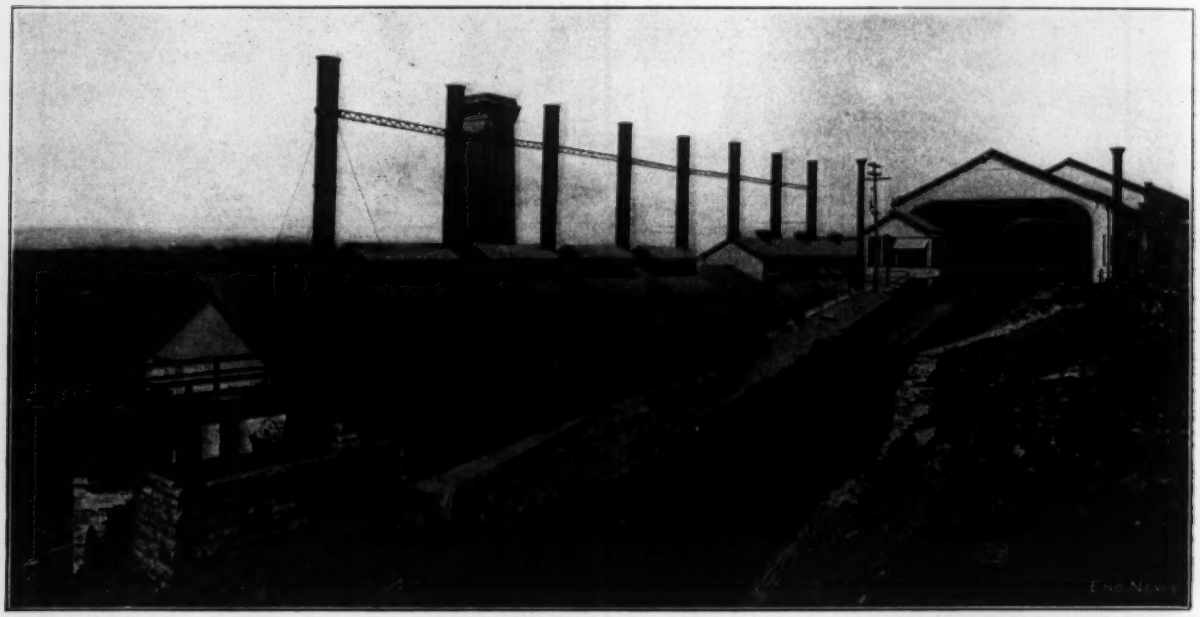


FIG. 4. VIEW NEAR HEAD OF MAHANOY PLANE, SHOWING KNUCKLE, HEAD HOUSE, BOILER HOUSE, OIL TOWER AND COALING TRACK

The installation of the engine and oil-house machinery, started upon the completion of the engine beds eleven months earlier, had also been made and after two weeks of trial, at first with the barneys alone and later with light trips, the new plant resumed active operation on June 17, 1912. The force was then reduced to less than twenty men who were occupied removing buildings, cleaning up the grounds, loading and shipping the contractor's plant and giving the finishing touches which enabled the construction department to turn the completed work over to the operating department on Aug. 1, 1912.

BUILDINGS AND STRUCTURES

The new Head House, 51x126 ft., is a steel-frame structure roofed with asbestos-slate shingles and sheathed with corrugated siding of the same material. The engineers' room, which projects beyond the Head House, is 16x14 ft. and has a large plate-glass window which affords an unobstructed view to and beyond the Foot.

A fireproof stone building, 13x20 ft., reaches from the basement floor of the engine room to the Head House roof, a height of 50 ft. This tower is used for the storage and serving of oil; entrance is gained thereto from the basement, engine room and track floors through doorways at the different levels, which are connected on the inside by metal stairways. An asbestos-slate roof, concrete floors, stone fire walls and metal window frames complete a construction which is perfectly fireproof. The interior surfaces of the rough stone walls are heavily covered with a smoothly surfaced, white-coated cement finish.

The dimensions of the engine room are 48x123 ft., with a 16x67-ft. extension to the south.

The interior wall surfaces of this room have the same smooth, white finish as those of the oil tower. The floor areas not taken up by engine beds, are built of transverse I-beams carried by the engine foundations and building walls; these are inclosed in concrete, sand finished on top and arched below.

Although the basement, which has the same area as the room above, is almost entirely taken up by the concrete engine foundations, those of the rendering and crown sheaves and, by the iron columns supporting the track-floor system, spaces between the concrete mass and the outer walls, on three sides, afford good storage room. The concrete basement floor, which forms a part of the heavy foundations, rests on the solid rock and averages 2 ft. in thickness.

From this basement, through recesses in the concrete, nuts and washers at the end of each of the 112 anchor bolts in the engine-room bed plates may be reached, removed and replaced when occasion requires. These bolts, generally 4 in. in diameter, pass through iron sleeves set in the concrete; between them and the bolts, fine sand has been filled in and tightly packed.

The irregular outline of the engine beds, the provision of these recesses, the setting of the sleeves and the open areas left in the foundation to save concrete made the construction of the forms for this work a very complicated and difficult operation.

At the west end of the boiler house is *a stone extension* with reinforced-concrete slab roof 48 ft. above its floor. The upper part of this building, the dimensions of which are 26x35 ft., is occupied by the reinforced-concrete bins to which ashes from the boilers are carried and from which they are delivered by three chutes in its northern wall, to cars on an adjacent track below. Only one-half of the area of this building is covered by its concrete floor, the balance being taken up with an open pit 14 ft. lower, in which is located the driving machinery of the scraper and elevator lines by which the ashes are handled. The water in these pits, which has no other drainage than by seepage, cools the hot ashes.

The sills and lintels, which were all cast on the ground in molds and hoisted into place, have a particularly neat finish. The same may be said of the coping over the light well and retaining walls all of which are guarded by substantial iron railings in cast-iron posts. Upwards of 11,000 cu.yd. of masonry entered into the construction of these works, 4000 yards of which were concrete in proportions of 1:2:4. Approximately two-thirds of this yardage was placed immediately under tracks in constant use, without interruption to the traffic over them.

Engine and Boiler Equipment

Power for the operation of the new plant is supplied by a double direct endless frictional rope hoisting engine of the heavy rolling-mill type, designed and erected by the Philadelphia & Reading Coal & Iron Co. The machine and foundry work upon these engines were divided between the shops of the company at Pottsville and those of the Reading Iron Co. at Reading; their erection was carried on by employees of the Coal & Iron Co.

The cylinders have a diameter of 54 in. with 72-in. stroke and are coupled direct to one of two drums having eight frictional differential rings 19 ft. in diameter. One of these two drums serves to divert the rope to the hoisting drum, the frictional surface of which only is to hoist the load. The steam cylinders are fitted with piston valves and double-bar link motion; the crank and drum-shaft journals are 26 in. in diameter, 48 in. long and have ball-and-socket bearings for shaft alignment. The shafts are of hollow nickel steel and are 30 in. square between journals to insure positive clamping of the drum hubs thereon.

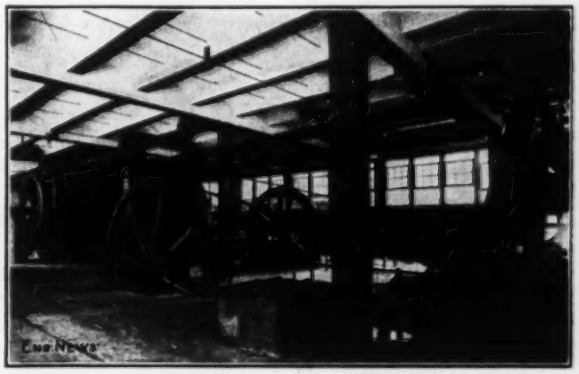


Fig. 5. Interior of Engine House at Mahanoy Plane, Showing Cable Sheaves

On each side of these drums are three frictional rollers, 10 ft. in diameter, which relieve the journals from the strains produced by the eight laps of frictional contact between the cable and the drums. The engines have steam reverse and hand-throttle valves with a steam pressure of 120 lb. Lubrication is effected by a continuous, self-oiling system governed by gravity and operating as follows: Oil delivered at the track level is carried by funnels and pipes, within the oil tower, to storage tanks in the basement. From these tanks, which constitute the base of supply, it is led by gravity to separators, which screen the suspended matter, and thence through filters of cloth fabric for thorough cleansing. It is then pumped to a reservoir in the upper oil house having an elevation 6 ft. above that of the track floor, thus insuring sufficient height to reach the engines.

Under this head, the oil flows by gravity to all the working parts and bearings of the engines and, its work of lubrication having been completed, is caught up and carried by return pipes to the basement tanks, and the process continued. The supply required to keep the apparatus in operation is only that lost by waste and consumed in running.

In connection with the engines, the following description of plane operation may not be out of place: The

2⅝-in. steel hoisting cable is carried between rails, over the plane tracks, on 14-in. pulleys, the centers of which are 15 ft. apart. This hoisting rope, which is fastened to the front end of the barney on the south track, passes from these pulleys over the vertical curve at the summit on four sheave wheels, 5 ft. in diameter, spaced 20 ft. apart. These are set in masonry pits connected with the alley ways which terminate in openings in the retaining wall to the north of the plane and along the foot-walk, adjacent thereto.

From the knuckle sheaves, the rope is taken over a 16-ft. crown sheave at the extreme summit, into the engine house. Inside the room, a 5-ft. sheave hung from the track floor, and two larger sheaves having diameters of 11 and 16 ft., respectively, upon concrete foundations, carry the cable to the 17-ft. rendering sheave at the extreme eastern end of the building. This revolves in a plane slightly inclined from the horizontal and after passing around it and over an intermediate 11-ft. idler, the cable is received by the rings of the two 19-ft. drums around which it is lapped eight times. It is then supported over a 5-ft. idler to the crown sheave at the summit of the north track and by the plane pulleys of this track to the front end of the second barney. These barneys, which weigh 11,500 lb. each, are connected at their lower ends by a 1½-in. diameter steel tail rope, which passes around a horizontal pulley mounted on trucks and carried by rails at the lower end of the pits at the Foot.

A balance frame near the pits supports the counterweight and pulleys from which ropes lead to this truck and by which the plane cables are kept taut. All the smaller pulleys and the sheave blocks of the larger ones are made of "gum" wood.

By this plan of endless rope hoisting and the alternate loaded and heavy movement over each plane track, the descending empty cars assist the upward loaded movement and thus materially relieve the engines. The hoisting strain on the rope is about 35 tons under a maximum load of 200 tons, at a hoisting speed of 30 miles per hour.

Steam is furnished by nine 270-hp. Stirling boilers, equipped with 18 Coxe automatic stokers, provided with forced fan blast and burning a mixture of anthracite rice and barley coal. Each boiler is furnished with an 8-in. automatic cushioned angle valve.

A direct-driven pressure blast fan, 18 ft. in diameter, with foundations and pit of concrete, is located in the northwest corner of the boiler house and provides sufficient air for the stokers. The belt-driven blast fan, 12 ft. in diameter, formerly used in connection with the old plant, has been connected to the blast pipe for emergency use. A separate concrete foundation in the center of the house carries a 3000-hp. Cochrane Feed Water Heater, the steam for which is supplied by the exhaust from the pump, stoker and ash-hoist engines and also a portion of that from the main hoisting engine.

Under the floor, and in front of the boilers, is a longitudinal pit in which a scraper line operates and delivers the ashes at the well in the ash-hoist building from which it is taken by elevators to the bins above for final disposition on cars.

Small supplementary engines, operating boiler-feed pumps and the ash-hoisting machinery, complete an equipment, the economical operation of which best appears in the small number of employees maintained at and around the boiler house. After the coal is received in the outer pockets from the cars above, until the ashes drop into cars from the chutes in the ash tower, the entire process of coal delivery, firing and removing of ashes is absolutely automatic; and only four men are required for necessary attention to the oiling and repairing of machinery, feeding of boilers, regulating stoker speed and other minor requirements.

Tracks and Grading

In addition to the grading necessary to the depression and elevation of the old empty and loaded tracks at the head, an additional loaded track has been provided. The four tracks of the heavy car yard have also been so extended as to increase their capacity from 90 to 135 cars, each track holding a full mountain train of 33 cars.

The excavations for these tracks, buildings and walls required the removal of 73,000 cu.yd. of the hardest kind of rock, four-fifths of which were taken out from under the tracks to a depth, over the area covered by the buildings, averaging 33 ft. The blasting for these excavations was done without loss of life or serious injury to men or property and the care with which this part of the work was conducted is emphasized by the fact that building construction proceeded simultaneously.

In connection with these improvements, directed by the construction department, enlargements of the empty and loaded car yards at the Foot, by which their capacities have been increased from 48 and 130 cars to 255 and 135 cars, respectively, were made by the operating department and completed at the same time as the other work.

These additions involved 50,000 cu.yd. of grading and included the raising and lengthening of the barney pits, a renewal of the 70- and 80-lb. rails on the plane with 80 and 90-lb. patterns and such elevation of the "undershot" bridge over the track leading from the Foot to the empty yards as will admit the passage of box-cars, previously impracticable. Plane operation was continuous during the entire construction period, except for the two weeks occupied by the lowering of the knuckle, and the movement averaged a trip up and down every three minutes. To this traffic there was not a single interruption, nor was there any retardation to the constant passage of cars in and out of the empty and loaded yards.

During this time, the extension to the coaling track was carried and maintained on shoring over 30 ft. high, the Frackville arch was extended, temporary changes to tracks were going on constantly, the operation of the scraper line was not delayed and ashes were disposed of as they were made. To accomplish this, the scraper line had been reversed, the cinders were delivered to a temporary bin at the west end of the boiler house and were taken away by carts. The work was done by contract on a percentage basis under the immediate supervision of the construction department, and the total force of laborers and mechanics employed at no time exceeded 150.

Conclusion

The efficiency and economy of this method of operation has been satisfactorily demonstrated by the results which have followed twelve months working of the new plant. The number of cars in each train has been more than doubled, the average hourly hoist has been increased from 30 to 76 cars, a maximum lift of 880 cars in 10

hr. has been attained, and there has been an experimental hoist of 98 cars in one hour.

The favorable location of Mahanoy Plane as a point for car collection and distribution has largely influenced this showing. The grades leading from the collieries, in all but the Shamokin region, are generally favorable to the loaded movement; and this has made possible such assemblage from the many breakers over the two areas, as has assured the hoisting, in 55 hr. each week, of an output which required a weekly plane operation of 138 hr. with the old plant.

The entire force employed at the Head and Foot and required for the operation and maintenance of the plane aggregates 50 men, divided as follows:

Plane foreman	1
Plane enginemen	3
Machinist	1
Boiler tenders, etc.	4
Locomotive engineers, firemen and ram tenders	10
Car runners	15
Ticket boys and car checkers	3
Switchmen	2
Laborers	5
Pulley makers, oilers and rope splicers	6

The Mahanoy Plane of today, in connection with the new classification yards at St. Clair now rapidly approaching completion, has given to the Reading Co. an improved, comprehensive service for the transportation of its anthracite tonnage more than adequate to meet the demands of many years to come.

The initial cost of construction has been lower and in many cases, *very much* less than would have been that of any one of the various proposed schemes of betterment which had long been considered and carefully studied; and the choice of a continuance of the older method and locations, in preference to the adoption of a longer low-grade route and new yards, appears to have been justified by a comparatively low cost for installation and maintenance and the facility and dispatch with which the heavy traffic is now handled.

Rules for Misfires in Blasting

One of the most frequent causes of fatal accidents in rock-excavation work is the setting off of charges which have missed fire when the men return to work after a blast.

The Engineering & Mining Journal has recently made a canvass of various prominent mining companies to ascertain their rules and practice with respect to holes which have missed fire. We reprint our contemporary's article below, as the subject is one of great importance to all contractors.

The danger of accident and death from the explosion of missed holes has been always recognized by mining companies and has been in most cases a matter of diligent attention and stringent rules. The current agitation in favor of safety first, and the attempts to reduce the mining death rate in the United States to a decent figure, render the subject of timely interest.

The great cause of mining accidents is falls of ground, and it will probably always so remain. The next most important source, as abundantly proved by figures for all countries, is explosions of powder. Among explosive accidents, it is probable that those due to missed holes predominate.

A missed hole once found, the question of how to render it harmless arises. In general, three lines of procedure are open, namely, to remove the powder by picking it out, to explode it with a new primer, to drill a new hole near by, but at a safe distance and in a safe direction, and explode the old hole with the new one. The object of our inquiry was to ascertain the opinion of those competent to have one, as to which of these methods was preferable.

In general it may be stated that the best practice favors shooting the old charge with a new primer, although exceptions to this are to be found. L. F. S. Holland states that the Smuggler-Union company uses the new primer and does not permit the powder to be picked out. Robert E. Hanley, of the Mammoth Copper Mining Co., favors the use of the new primer in most cases. This is also the practice at the Calumet & Arizona. Mr. Gorhing, superintendent of mines, writes that in his opinion the only method of treating a missed hole is to insert a new primer and that he knows of no circumstances under which it would be safe to drill a new hole nearby, or to clean out the old powder. Frank Juliff, foreman of the same company, concurs and adds that he would advise that no drilling in the vicinity be done in drifts, raises or slopes while any powder remains in the holes. M. W. Mitchell, the other Calumet & Arizona foreman, agrees in general, but would permit the cleaning out of the powder in exceptional cases.

W. H. Staver and E. B. Miller, of the Liberty Bell, unite in recommending shooting the old charge. In the event of this method failing, Mr. Staver favors cleaning out the powder or possibly drilling a new hole, if this can be safely done. Mr. Miller remarks upon the fact that the collar of the missed hole may be shot off, leaving no room for a new primer. In such case, he would plaster the new primer over the hole and shoot it. He would never dig out the powder, but would permit drilling a new hole when necessary.

The rules of the Hecla Mining Co. governing the subject of misfires are quoted by James F. M'Carthy, manager, as follows:

Miners who have blasted, on coming off shift, must notify the shift coming on if there have been any missed holes and how many, so that they may have full knowledge of the matter. In such cases also the miners coming off shift must write plainly on the blackboard in the shaft house the places where they have left any missed holes and the number of such missed holes. Miners going on shift must examine said blackboard for the record of any missed holes before going to work.

Every employee, after spitting a fuse, must remain within hearing distance and count the number of shots he hears and carefully note the number of missed holes, if any. No employee shall under any circumstances approach a missed hole within 20 min. after spitting the fuse.

Employees must carefully examine the workings before setting up machines, for loose or scaling rock or any element of danger and all missed holes must be fired before drilling is commenced. Picking giant powder out of a hole is strictly forbidden. No tamping of powder with steel or iron bars is allowed.

It will be noted that the rules prohibit the cleaning of the holes. A copy of these Hecla rules is given every man on the day he begins to work, and a copy is kept posted in the shaft house.

Percy E. Barbour, manager of the Uwarra Mining Co., writes as follows:

I am not in favor of drilling a hole adjacent to a hole which is full of unexploded powder. In our present work we invariably shoot the hole over, first carefully drawing out the tamping and old primer and inserting a new one. Our primers are made by inserting a fuse and fulminate cap in the end of a stick of powder, the top of which is tied around a fuse. Therefore after the tamping is withdrawn this primer can be pulled out by a gentle tug on the fuse. The old fuse is cut off and the primer and old cap put back in the hole and a new primer made and inserted. If, as sometimes happens, the primer explodes and leaves unexploded powder in the hole we handle it in one or two ways. If there is little powder in the hole and shooting will not seem to break enough rock to pay for smoke delay we take out the powder, but we first fill the hole with water to prevent any chance of explosion. If the contents seem to promise sufficient results we put in a new primer and shoot the powder that is left. As to the detection of missed holes: In our drift work it is easy to tell by the looks of the face whether the hole has failed to go or not. If the hole has been shot, but leaves a boot-leg, these are all tried with a tamping stick to discover if there is any unexploded powder left in the hole.

To pull out the old primer is equivalent in danger to cleaning the hole. Presumably, this primer is on the top of the hole. Mr. Bilharz, general manager of the Doe Run Lead Co., follows the same plan and recommends that the hole be cleaned and that no new hole be drilled.

An Increase in the Exports of Manufacturers will be the leading feature in the export record of the United States in 1913. According to the Department of Commerce, the export of railway cars will show a total approximately double that of last year, the figures for the nine months ending with September being $30,500,000. Automobiles and parts, including engines and tires, show a total export value of $30,000,000 in the first nine months of this year, as against $25,000,000 for the same period of 1912. Metal-working machinery shows an increase of $1,500,000 for the same period; pipes and fittings, an increase of $3,500,000; copper manufactures, an increase of $12,750,000; while refined mineral oils for the same period show a total exportation of $102,000,000, against $88,000,000 in the same months of 1912.

French Tests on Oil-Mixed Concrete

A series of tests on the effect of mixing a heavy mineral oil with concrete is described in some detail by M. R. Feret, Chief of the Ponts et Chausées Laboratory at Boulogne-sur-Mer, in the September-October number of the *Annales des Ponts et Chausées*. These tests were made in order to discover, if possible, the effect of the addition of oil in increasing the density of concrete, which increase in density has for its most practical effect the increasing of the water-repelling qualities of the concrete. The experimenter states that independent of the changes in volume due to temperature variation, concrete mortars expand or contract according as they gain or lose humidity, and the repetition of these movements is a cause of the cracking in such structures as are exposed to the weather or more generally to variations in the hygrometric state. In opposing the penetration of water oil ought to reduce these defects, and consequently should be an excellent guarantee for any mortar exposed to air.

Mr. Feret attempted at first to check the experiments conducted by Logan Waller Page, of the Office of Public Roads in the United States Department of Agriculture, but was unable to procure precisely the kind of oils that Mr. Page had recommended for waterproofing or mixing with concrete. Finally the oils which he did use were four, as follows: (a) Russian naphtha, relatively fluid, sold commercially as a lubricating oil; (b) a heavy petroleum residue, American origin, black and thick, neutralized but not purified, sold also as a lubricant; this oil left in any vessel from which it was poured a light solid deposit; (c) an American residual petroleum somewhat similar to (b) but purified, thicker than (b), not leaving any solid deposit; (d) a mixture of one part of heavy coal-tar oil and two parts of semi-fluid rosin containing some impurities, probably dust.*

These oils were mixed with standard French portland cement and a standard sand in mixtures of 1:3 and 1:5 as noted hereafter and in proportions of 5 to 10% of the oil, percentage being by weight of oil to weight of included cement.

The first tests were made on adhesion. Small prisms of newly made oil-mixed mortar with no oil, 5% oil and 10% oil were molded as continuations of 11-year old normal 1:3 cement-mortar prisms which had been in the laboratory for some time, and were broken in such manner as to insure the breaking at the joint It was found that the adhesion at this joint decreased with the amount of oil in the mixture in the ratio of about 100 to 95 to 75 for the 0% oil, 5% oil and 10% oil, respectively.

The next set of texts was on the effect of the oil on the initial set. Small cubes with no oil, 5% oil and 10% oil were made and tested under compression 24 hr. after manufacture. It was found that the initial set was decidedly affected by the inclusion of the oil.

The next set of tests was made on investigation of the absorption qualities of the oil-mixed concrete. For this test two types of mortar were used; one a lean and porous mixture, containing five parts by weight of fine sand to one of cement and gaged with 16.2% water; the other rich and dense, with three parts of sand to one of cement, gaged with 10.5% of water. Of each mortar small cubes were made and after being subjected to a drying process were tested to ascertain their absorption quality and also their compressive strength. It was found that in all cases the compressive strength dropped off decidedly with the addition of oil. In the lean mixes the absorption of water became markedly less as the oil content was increased. In the dense mixes the decrease in porosity with the increase in oil was present, but not in such pronounced form as in the lean mixes.

In the Russian and American oils (a), (b) and (c), it is calculated that the mean loss of compressive strength in the lean mortars was 14% for 5% of oil and 22% for 10% of oil, and in the rich mortars the losses were 24% for 5% of oil and 37% for 10% of oil.

An attempt was made to discover the effect of sea water on oil-mixed concrete by submitting blocks to mixtures which should give an accelerated effect similar to the effect of sea water, but no definite results were seen.

The next set of tests was upon the investigation of the permeability of oil-mixed concrete under high pressures. In this test the dense mortar was used with 10⅓% of water and the blocks subjected to pressures as high as 50 lb. per sq.in. The oil reduced the permeability of the blocks in a very marked manner, and this impermeability persisted over the entire period of the tests, which were continued through 77 days. Mr. Feret remarked, however, that the tests would have been of much more value could they have been made on concrete with large aggregates, but the facilities of his laboratory did not permit such tests.

Conclusion

In resumé Mr. Feret states that the addition of heavy mineral oil to mortars made of portland cement diminishes perceptibly the compressive resistance and the adhesive power of the mortar. That, however, is of minor importance if at the same time the density and impermeability of the mortar is increased. With mortars sufficiently compact so that they will allow the admission of only a small amount of water under the conditions which it is expected they will be used, a small addition of heavy oil should diminish perceptibly the permeability. It even should stop all infiltration. But the oil seems to have only a weak adhesion to the mortar which it surrounds and it would seem that it might easily be driven out when the water pressure passes a certain limit, depending upon the composition of the mortar. Oil as a waterproofing agent is in the same case with many other pretended waterproofing agents which do not act except as void fillers and which have no adhesion to the cement or sand. As opposed to these those which leave a solid deposit less easily driven out have a chance of being much more effective. An attempt should then be made to correct the granulametric composition of the mortar in such a manner as to insure a maximum density; it is much simpler to obtain this result by a judicious choice of sand and by proportioning the mix than by the addition of any waterproofing agent.

The question of cost should also enter into this matter of waterproofing. For example, heavy American oils approaching the type prescribed by Mr. Page costs at Boulogne about 43 fr. per 100 kilo. If one adds only 5% of such an oil to a concrete containing 300 kilo. of cement to the cubic meter the increase in the price of the concrete

*The mixture (d) of rosin and coal-tar oil gave very bad results in all tests. Mr. Feret states that perhaps other more fluid mixtures of analogous residuals would give better results. He states also that the question of the merit of this type of oil should be studied, for the product would cost in France four or five times less than the heavy American oils.

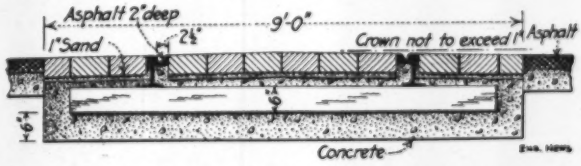
would be 6.45 fr. per cu.m. It would be much cheaper and at the same time doubtless more effective to add to the mixture a third of the proportion of cement.

Two Methods of Paving Street-Railway Tracks

The paving of street-car tracks is frequently a troublesome problem, and sometimes a source of dispute owing to the opposing opinions of the municipal authorities and the street-railway company's officials. Two special methods of paving the tracks are noted below.

Brick Paving with Asphalt Flangeways at Tulsa, Okla.

Where brick paving is used with T-rail track, the flangeways against the rail heads are formed usually either by special nose or beveled brick or by placing the ends of the ordinary brick beneath the rail head and crowning the pavement so that its center line is level with the top of the rail. The latter plan, however, breaks up the normal contour of the street. At Tulsa, Okla., brick paving has been used for the car tracks, with nose brick for the flangeways, but in April last the nose brick could not be obtained, and in order to avoid having the streets open for an indefinite time the new method described below was used experimentally. The results have been so satisfactory, that in September the Board of Commissioners adopted it officially.



Brick Paving with Car-Track Groove Formed of Asphalt and Concrete; Tulsa, Okla.

The track is laid with 7-in. T-rails on wood ties 6 in. thick, with a 6-in. concrete base and concrete filled between and over the ties. Upon the concrete is a 1-in. cushion bed of sand for the bricks, which are grouted with a 1:2 cement grout. For the new style of groove paving, a concrete rib is laid along the inside of each rail, being carried up nearly to the underside of the rail head and for a width of 2½ in. from the head. Upon this is a top course of asphalt 2 in. thick, in which the groove is formed. To insure adhesion of the asphalt, a naphtha coat is applied to the brick and concrete immediately before laying the asphalt.

The material is tamped with a hot tamping iron, but it is suggested that if much work was to be done on an existing line a roller could be devised, attached to a car running on the track. The asphalt must be of good material to stand the traffic, and that used at Tulsa (to meet the climatic conditions) is Trinidad asphalt mixed with crude oil, of about 58 to 60 Dow standard.

For the drawing and information we are indebted to T. C. Hughes, City Engineer of Tulsa. He states that this is a recent innovation and has been in use only a few months, but on a street which carries a very heavy traffic, leading to one of the principal railway stations. The street cars are of the four-wheel or single-truck type. The asphalt next to the rails serves to make a tighter joint than can be made with such rigid material as nose brick laid with cement grout. Observation shows that the street vehicles will travel over these tracks and (in turning out) will mount the rails with less difficulty than with any other system which has been used in this city.

It is believed that this arrangement will stand the test of street wear, and that by reason of its flexibility it offers a better weather-tight bond between the paving and the rails than anything so far used. No under drainage is used in the car tracks in this city, except that at low places a surface drain is provided between the rail connections and the storm sewers.

Concrete Paving at Texarkana, Tex.-Ark.

The Southwestern Gas & Electric Co. is using concrete paving between and outside the rails. It has used this construction since the Fall of 1911, and now has it on 5360 ft. of single track. It was adopted in the expectation of getting better service than from brick, although brick is used on the sides of the streets.

There is a 6-in. foundation of 2½-in. trap rock, which provides drainage and upon which the ties are laid. Between the ties is a 6-in. bed of concrete (1:3:5), and over this is the 5-in. paving course of concrete (1:2:4). The concrete was not mixed very wet, but was well tamped to bring the water to the surface and make a smooth finish. A template was used to shape the surface to a ¾-in. crown and to form the 1¾-in flangeway groove. No steel reinforcement is used. Expansion joints are formed at intervals of 8 ft. by inserting strips of sheeting board, of taper or wedge section. The track is laid with 4½-in. 70-lb. T-rails of the Am. Soc. C. E. section, upon creosoted pine ties spaced 24 in. c. to c.

Traffic was first operated over the track as laid on the broken stone, so as to insure complete settlement of this ballast, which was then given a final tamping and the track brought to surface before depositing the concrete. At special work the broken stone base was filled with cement grout before placing the concrete so as to form a solid base. The street was closed to traffic, both of cars and street vehicles, for two weeks after laying the concrete.

The general manager of the electric company, W. L. Wood, Jr., informs us that this construction has proved very satisfactory, and that the concreting was an especially good job, being done under close supervision. He states that such pavement is not likely to be satisfactory unless the work is done properly. The paving is in good condition and shows very little wear. There was a slight indication of wear at the edge of the flangeway grooves and along the outer edge at the rail joints, but this was stopped by the application of a little asphalt. The street traffic is fairly heavy. The car traffic is not very heavy, but includes single-track and double-track cars weighing 25,000 to 38,000 lb.

The cost of this construction is about $24,000 per mile of single track. The only maintenance expense has been asphalt filling for the expansion joints and along the rail, as noted above.

"Districting" Cities is a not uncommon practice in Europe, especially in Germany, but the first American city to adopt the plan is Minneapolis, Minn. A law enacted by the Legislature of Minnesota, at its last session, permits cities with a population exceeding 50,000 to establish exclusion districts. When petitioned by 50% of the property owners in a neighborhood, a City Council may, by a two-thirds vote, designate such neighborhood as a residential or an industrial district.

Unusual Girder Work in a Pittsburgh Theater

In the Sheridan Square Theater, East Liberty, Pittsburgh, which has just been completed, the unusual shape of the building lot brought about a peculiar arrangement of the balcony framing. The lot, located at the corner of Penn, Center and Sheridan Aves., is triangular, with the stage at the point and the balcony across the base of the triangle. As the house is to be used for vaudeville, only a small stage was provided (depth 24 ft., proscenium-arch width, 32 ft.). The auditorium is of the arrangement now popular, having medium seating capacity (2000), and provided with but a single balcony. The structural arrangement is on strictly modern lines also, in avoiding all columns under the balcony, carrying the entire balcony on girders spanning the auditorium below from wall to wall without intermediate support.

The plan Fig. 1 and the section Fig. 2 give the balcony framing. Three main transverse girders support the balcony; the middle of these, girder *A*, is the largest and heaviest, and it supports the large girder *B* by means of the shorter transverse girders *D*. The rear girder *H* is supported directly on the wall across the rear corner of the triangle.

Girder *A* is unusually large and heavy; it supports a considerable portion of the balcony area, directly and through supporting part of the weight of girder *B*. Its total length is 103 ft. 8⅞ in. out to out, its depth 76½ in. back to back of angles, and it weighs 53 tons. Two ½-in. plates stitch-riveted together form the web; each flange consists of two angles 8x8x¾ in., two side plates 15x$1\frac{1}{8}$ in., and three cover plates 20x¾ in. To facilitate hauling to the site and erecting, the girder was made in three sections, which were hoisted into position on blocking and riveted up when in place. Both web and flange are fully spliced, but the cover-plate is not divided, being field-riveted to the end section. Fig. 3 gives some details.

Girder *B* is remarkable in being of broken-line profile, to conform to the curve of the balcony cross-section and avoid unnecessary projection below, as the space available for floor depth was closely limited. Fig. 4 shows this girder.

The balcony framing was designed for a live-load of 125 lb. per sq.ft. on the smaller beams and 100 lb. per sq.ft. on the girders.

The roof framing over the theater auditorium was also affected by the shape of the lot. The main support con-

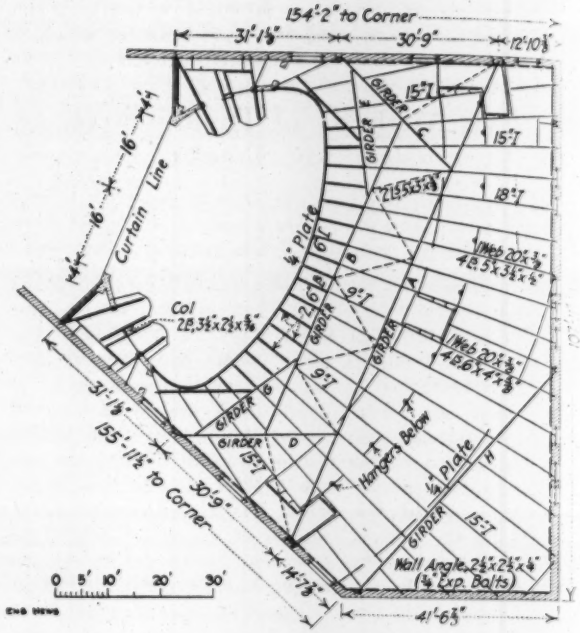


FIG. 1. PLAN OF BALCONY FRAMING

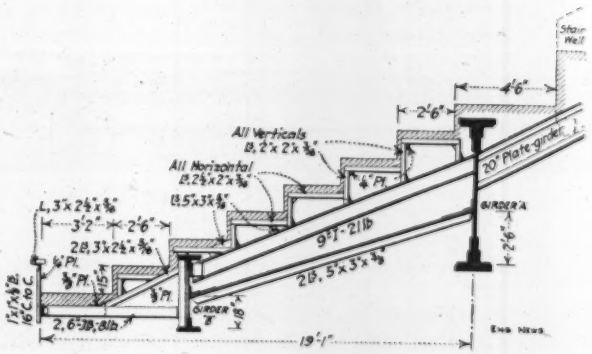


FIG. 2. VERTICAL SECTION OF LOWER PART OF BALCONY

FIGS. 1 AND 2. UNUSUAL GIRDER WORK, SHERIDAN SQUARE THEATER, PITTSBURGH

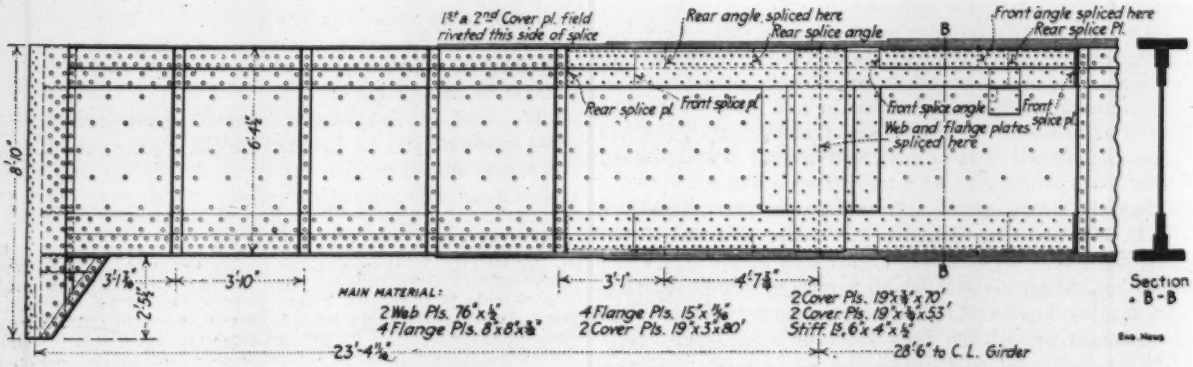


FIG. 3. SPLICE OF THE LARGE BALCONY GIRDER

-sts of two transverse trusses and five longitudinal trusses, the latter supporting the roof purlins on which the concrete roof-slab rests. The largest of the roof trusses is 101 ft. long and 12 ft. 4 in. deep; each flange consists of four angles 6x6x⅝ in., and a web plate 13x½ in. This truss weighs about 18 tons, only one-third as much as the balcony plate-girder, though of approximately the same span. It was erected fully assembled, by the help of an extended gin-pole.

Of the other structural details, it may be noted that the floors consist of a 6-in. concrete slab with wood surface. The auditorium floor beams are supported by columns direct. The stage has a wooden central portion which can be altered for various floor arrangements; the rest of the stage construction is fireproof. A cylindrical horizontal water tank, 6 ft. in diameter by 22 ft. long, over the stage, supplies the stage fire-sprinkler system. It is hung by steel straps from the roof beams.

The total weight of steel in the job was 317 tons. It was erected without a mishap.

The theater was designed by the H. E. Kennedy Co., architects, and built by W. B. Bennett, Pittsburgh. Haggart Bros. were the structural engineers, and designed the steelwork.

Code of Ethics and Recommended Schedule of Compensation of the Maine Society of Civil Engineers*

The Maine Society of Civil Engineers, seeking to maintain a high standard of practice and conduct on the part of its members as a safeguard of the important financial, technical and esthetic interests entrusted to them, considers that it is unprofessional and inconsistent with honorable and dignified conduct for any member of this Society to violate any of the following general principles:

GENERAL PRINCIPLES

(1) In all of his relations a member should be guided by the highest principles of honor.

(2) While a member should consider the protection of a client's or employer's interest his first professional obligation, and, therefore, should avoid any act contrary to this duty, he should remember that his duties to the public demand full recognition and consider it his duty to make every effort to remedy dangerous defects in apparatus or structures in dangerous condition, and should bring these to the the attention of his client or employer in a manner which will insure rectification. In any case where his services require him to act in a judicial capacity he should be guided by the highest principles of justice.

*Adopted by the Society at annual meeting Feb. 10, 1913.

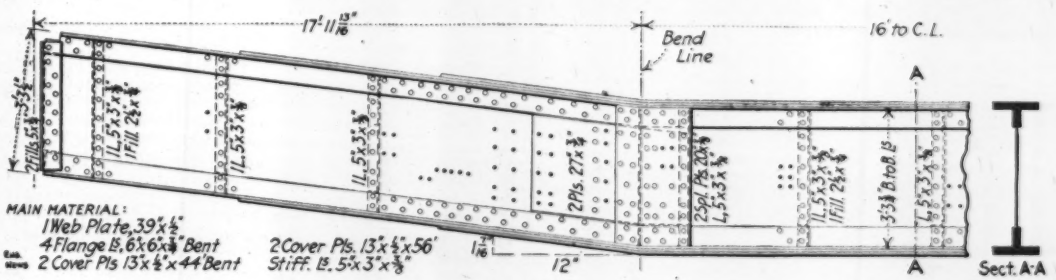


FIG. 4. SKETCH OF GIRDER B

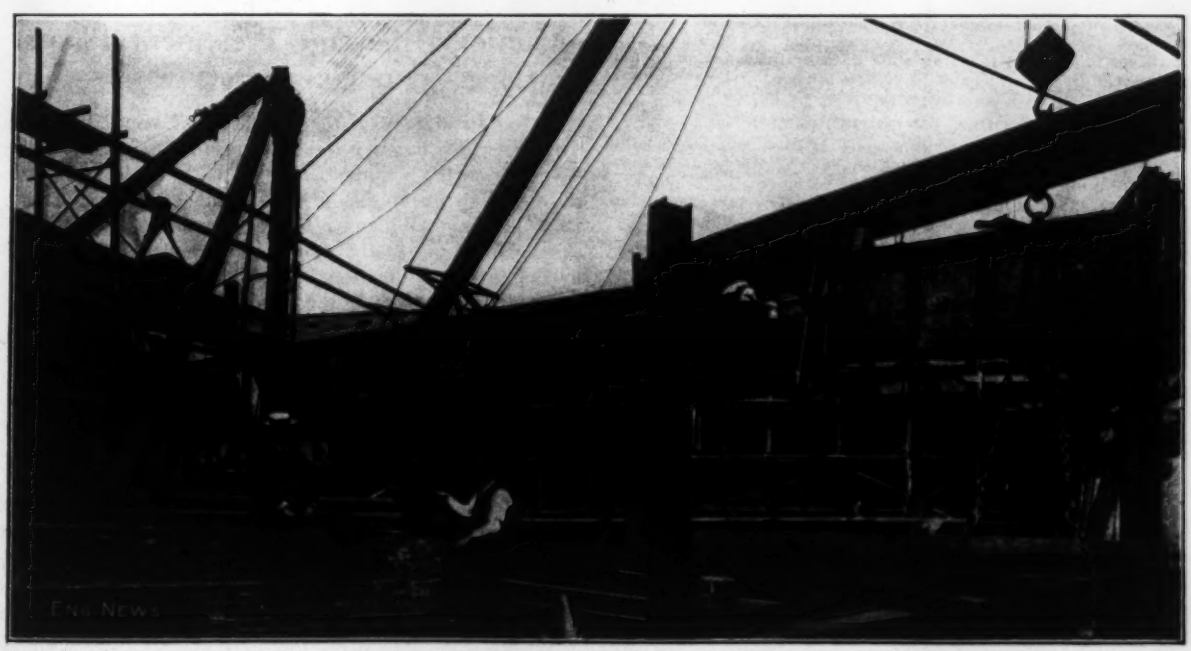


FIG. 5. ERECTING BALCONY GIRDERS OF SHERIDAN SQUARE THEATER, PITTSBURGH
(Girder A and column for girder D in foreground; girder H at right background.)

(3) It is the duty of a member to satisfy himself to the best of his ability that the enterprises with which he becomes identified are of legitimate character. If after becoming asociated with an enterprise he finds it to be of questionable character, he should sever his connection with it as soon as practicable.

(4) A member cannot honorably accept compensation, financial or otherwise, from more than one interested party, without the consent of all parties. A member, whether consulting, designing, installing or operating, must not accept commission, directly or indirectly, from parties dealing with his client or employer.

(5) A member called upon to decide the use of inventions, apparatus, or anything in which he has a financial interest, should make his status in the matter clearly understood before engagement.

(6) The seeking out of a possible client and the offering to him of professional services on approval and without compensation, unless warranted by personal or previous business relations, tends to lower the dignity and standing of the profession and is to be condemned. As also is the practice of offering commissions or otherwise improperly soliciting professional work, either directly or by an agent.

(7) A member should be mindful of the public welfare and should participate in those movements for public betterment in which his special training and experience qualify him to act. He should not, even under his client's instructions, engage in or encourage any practices contrary to law or hostile to the public interest.

(8) No member shall attempt to injure falsely or maliciously, directly or indirectly, the professional reputation, prospects or business of a fellow practitioner.

(9) No member shall accept employment by a client while the claim for compensation, or damages, or both, of a fellow member previously employed by the same client and whose employment has been terminated, remains unsatisfied, or until such claim has been referred to arbitration, or issue has been joined at law, or unless the member previously employed has neglected to press his claim legally.

(10) No member shall attempt to supplant a fellow practitioner after definite steps have been taken toward his employment.

(11) No member shall compete with a fellow practitioner for employment on the basis of professional charges, by reducing his usual charges and attempting to underbid after being informed of the charges named by his competitor.

(12) No member shall accept any engagement to review the work of a fellow member for the same client, except with the knowledge or consent of such member, or unless the connection of such member with the work has been terminated.

(13) Any data or information which a member obtains from his client or employer, or which he creates as a result of such information, must be considered confidential and while he is justified in using such data or information in his own practice as forming part of his professional experience, its publication without express permission is improper.

SCHEDULE OF COMPENSATION

Resolved: That the Maine Society of Civil Engineers considers the following schedule of charges a just and reasonable minimum recompense for proper service:

(a) Members of field parties for extensive surveys, under a chief engineer or an organized engineering department:

Chief of field party	$150 to $250 per month
Transitman	$100 to $150 per month
Camp Draftsman	$ 75 to $100 per month
Levelman	$ 65 to $100 per month
Topographer	$ 65 to $100 per month
Level Rodman	$ 50 to $ 75 per month
Head Chainman	$ 50 to $ 75 per month

The above prices to be net above all necessary expenses.

(b) Inspectors on construction work, $75 to $150 per month, according to nature and importance of work.

(c) General surveying practice; farm lines, wild land surveys, ordinary leveling to determine approximate altitudes, and all other work not requiring plans or written reports, $5 to $10 per day and expenses.

(d) Topographical surveys; city or town work comprising the establishing of lot or street lines from old records or monuments; laying out and plotting new additions; municipal work for towns or cities not having city engineers; court surveys including time spent in attendance at court; laying out and superintending construction work from plans of other engineers; and services on design of works to cost less than $5000; $6 to $15 per day and expenses, and salaries of assistant and an allowance of 25% of such assistants' salaries for office expenses.

(e) For full professional services and management, including preliminary studies and detail drawings and specifications, awarding of contracts, active and continuous supervision, testing and inspection, but not including cost of investigations requiring borings, soundings, etc., to obtain data for proper designing; 5 to 10% of cost, according to the magnitude of the work.

(f) For full professional services including preliminary studies, detail drawings and specifications, and also including the active conduct of the construction work on a force account basis without the aid of a general contractor; all accounts being approved by the engineers and rendered to the owner for direct payment; 10 to 15% of the cost, according to the magnitude of the work.

(g) For preliminary study and report, preparing detail drawings and specifications, awarding contracts and acting in a general supervisory capacity during construction, including office consultation but not including continuous supervision and inspection, testing, etc., 3 to 5% of cost of work; or 2 to 3% of cost for services up to and including letting of contract or beginning of construction, and thereafter a monthly charge for consultations and general supervision, amounting to from ¼ to ½% of cost.

(h) For preliminary study of new projects to cost $5000 or more, a per diem charge of not less than $15, increasing this charge according to the magnitude and importance of the project.

Where a percentage charge is made, it is intended to cover all ordinary office expenses, but if the work is such that these will be unusually large in comparison, it is proper that they should be added, but it should be so stipulated in the agreement. All traveling expenses to be paid by the client.

Where a per diem charge is made, 8 hours of service shall be considered one day. While absent from home office, however, or while in attendance at court, one day of 24 hours shall be considered one day, irrespective of the actual time devoted to the case.

Where charges are based on a percentage of the cost, the commissions are to be computed on the estimated cost pending execution or completion.

When alterations or additions are made in contracts or specifications at the instigation of the owners, or when services are required in connection with legal proceedings, etc., a charge based on the time and trouble involved should be made in addition to the commissions herein provided for.

Agreement as to amount and time of payments should be made between the engineer and the owners early in the progress of the work.

E. E. GREENWOOD, JOHN CALVIN STEVENS, SETH A. MOULTON, H. S. BOARDMAN, H. C. SHAW, Committee.

Municipal Sewage-Treatment Plants in New Jersey

Owing in large part to its density of population and the care which has been taken to protect its public water supplies, shellfish industries and bathing beaches, the state of New Jersey has a large number of sewage-treatment plants. At many of these plants the treatment is carried to an unusually high degree, even to the extent of hypochlorite disinfection. Nearly all the plants have been built since 1900, the date of the creation of the State Sewage Commission. The work of this Commission was entrusted to the State Board of Health in 1908.

In August, 1913, there was compiled under the direction of R. B. Fitz-Randolph, chief of the Division of Foods, Drugs, Water Supply and Sewerage of the New Jersey State Board of Health, a table giving detailed information regarding 144 municipal, institutional and private sewage-treatment plants in New Jersey. We reprint the table in condensed form on the opposite page, having omitted all the institutional and private plants, and a few municipal plants servingsless than 100 people each, and also having omitted some of the data relating the average rates of treatment, chemicals, trade wastes, and streams and stream flow.

DATA RELATING TO SEWAGE-DISPOSAL PLANTS IN NEW JERSEY

Prepared by the Division of Foods, Drugs, Water and Sewage of the Board of Health of New Jersey

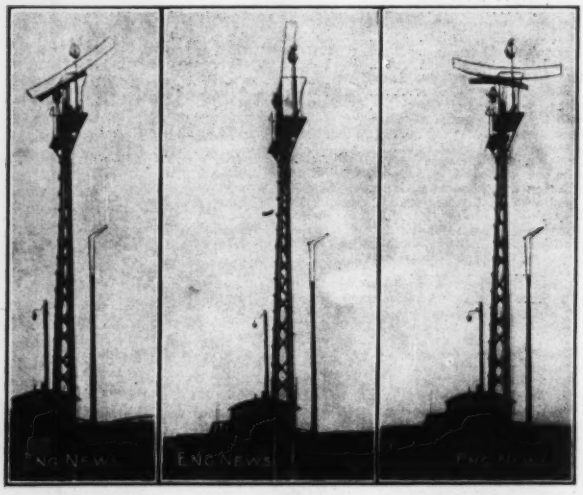
Municipality	Population Winter	Population Summer	Date installed	Installed to protect	Plant consists of	Sewage flow av. gal. per day	Sedimentation period	Dilution Min.	Dilution Aver.	Miles to water intake*
Allenhurst	300	3,000	1907	Bathing beach	Sedimentation and sea discharge	100,000	8 hr.	Very high		
Asbury Park	10,000	200,000	1909	Bathing beach	Sedimentation and sea discharge	1,700,000	6 hr.	Very high		
Audubon	1,300	.....	1913	Stream	Sedimentation, contact bed and sand filters	.....	.....	.....		25
Atlantic City, part of	3,000	30,000	1910	Shellfish	Sedimentation and disinfection	160,000	1 hr.	High		
Avon	400	4,000	1906	Bathing beach	Sedimentation and sea discharge	200,000	2½ hr.	Very high		
Beach Haven	270	2,000	1913	Bathing beach	Sedimentation and sea discharge	70,000	8 hr.	Very high		
Belmar	1,500	7,000	1911	Bathing beach	Sedimentation and sea discharge	150,000	8 hr.	Very high		
Bordentown	4,300	.....	1911	Stream	Sedimentation, double contact and sand filters	260,000	12 hr.	8.5	72	8½
Bradley Beach	1,000	8,000	1903	Bathing beach	Sedimentation and sea discharge	80,000	10 hr.	Very high		
Bradley Beach	800	2,000	1912	Bathing beach	Sedimentation and sea discharge	60,000	8 hr.	Very high		
Bridgeton	10,000	.....	1911	Shellfish	Sedimentation, disinfection and 2 hours' storage	1,000,000	8 hr.	6	43	
Bridgeton	100	.....	1911	Shellfish	Sedimentation, disinfection and 2 hours' storage	10,000	8 hr.	Very high		
Brown's Mills	300	.....	1912	Water supply	Sedimentation, contact beds and disinfestion	10,000	8 hr.	20	42	2
Burlington	8,500	.....	1892	Stream	Sedimentation, broad irrigation	700,000	½ hr.	½	9	7
Bivalve	100	.....	1910	Shellfish	Pail system	.....	.....	.....		
Caldwell	2,300	.....	1913	Water supply	Sedimentation	.....	.....	None		3
Cape May	2,500	27,000	1913	Bathing beach	Sedimentation and sea discharge	1,000,000	2 hr.	Very high		
Cape May Real Estate Co.	300	.....	1912	Shellfish	Sedimentation and disinfection	18,000	6 hr.	Very high		
Carlstadt	3,900	.....	1909	Stream	Sedimentation	125,000	8 hr.	Little		
Chatham-Madison	6,500	.....	1911	Water supply	Sedimentation, double contact, sand filters	340,000	2 hr.	36	210	19
Collingswood	4,800	.....	....	Stream	Sedimentation and contact beds	475,000	8 hr.	1	6	
Deal Beach	280	3,000	1910	Bathing beach	Sedimentation and sea discharge	150,000	7 hr.	Very high		
Delford	1,005	.....	1905	Stream	Sedimentation	80,000	12 hr.	193	1160	
East Rutherford	4,300	.....	1909	Stream	Sedimentation	210,000	15 hr.	Very little		
Englewood	10,000	.....	1911	Stream	Sedimentation	560,000	3½ hr.	2.5	16	
Essex Falls	500	.....	1909	Water supply	Sedimentation, contact beds and sand filters	40,000	4 hr.	8	48	4
Flemington	2,800	.....	1898	Water supply	Screens and land filtration	200,000	6 hr.	0.6	6	8
Freehold	3,300	.....	1894	Stream	Screens and land filtration	400,000	6 hr.	0.2	1.5	
Haddonfield	4,200	.....	1903–10	Stream	Sedimentation, sprinkling filters, secondary sedimentation	225,000	5 hr.	22	106	
Haddon Heights	1,500	.....	1911	Water supply	Sedimentation and sand filters	50,000	8 hr.	0.8	4	
Interlaken	.....	.....	1907	Stream	Sedimentation and pumps to Loch Arbor	10,000	10 hr.	.....		
Island Heights	310	2,000	.....	Shellfish	Screens and sand filters	60,000	.....	Very little		
Keyport	3,600	.....	1911	Shellfish	Sedimentation and disinfection	250,000	10 hr.	7	55	
Lakehurst	750	.....	1907	Stream	Sedimentation and sand filtration	10,000	8 hr.	68	372	
Lakewood	4,000	3,000	1909	Stream	Sedimentation and sand filtration	300,000	8 hr.	6	86	
Longport	120	1,200	1912	Shellfish	Sedimentation and disinfection	80,000	3 hr.	Very high		
Long Branch	13,300	30,000	....	Bathing beach	Screens and sea discharge	800,000	....	Very high		
Manasquan	1,600	8,000	1905	Bathing beach	Sedimentation and sea discharge	40,000	6 hr.	Very high		
Margate City	100	1,000	1910	Shellfish	Sedimentation and disinfection	30,000	7 hr.	High		
Merchantville	2,000	.....	1909	Stream	Sedimentation, trickling filters and sand filters	260,000	10 hr.	None		
Millville	12,500	.....	1908	Shellfish	Sedimentation, contact beds and disinfection	800,000	4 hr.	31	250	
Moorestown	4,000	.....	1901	Stream	Sedimentation and trickling filters	500,000	3 hr.	5	22	
Morristown	12,500	.....	1910	Water supply	Sedimentation, contact bed and sand filters	630,000	8 hr.	4.7	37	18
Neptune Twp	2,000	3,000	1911 & 13	Bathing beach	Sedimentation and sea discharge	350,000	3 hr.	Very high		
Newton, Clinton St	3,000	.....	1905	Water supply	Sedimentation and sand filters	450,000	8 hr.	0.7	4.5	50
Newton, Sparta St	1,500	.....	1905	Water supply	Sedimentation and sand filters	50,000	12 hr.	1.5	10	50
Ocean City	2,000	25,000	1911	Shellfish	Sedimentation and disinfection	250,000	5 hr.	High		
Ocean Grove, large	2,000	30,000	1909	Bathing beach	Sedimentation and sea discharge	500,000	8 hr.	Very high		
Ocean Grove, small	700	7,000	1909	Bathing beach	Sedimentation and sea discharge	100,000	6 hr.	Very high		
Pemberton	800	.....		Water supply	Sedimentation, sand seepage	30,000	½ hr.	.....		6
Plainfield, old	20,000	.....	1900–05	Water supply	Sedimentation and double contact	1,400,000	8 hr.	0.6	23	
Plainfield, new	.....	.....	.....	Water supply	.....	.....	.....	.....	.....	
Point Pleasant	1,000	2,500	1909	Bathing beach	Sedimentation and sea discharge	100,000	2 hr.	Very high		
Princeton N.E.	4,200	.....	....	Stream	Sedimentation and sand filters	175,000	7 hr.	Very little		
Princeton, college	1,500	.....	....	Stream	Sedimentation, sprinkling filters and sand filters	.....	.....	Very little		
Princeton, W.	500	.....	....	Stream	Broad irrigation	50,000	.....	.....		
Princeton, White City	500	.....	....	Stream	Sedimentation and broad irrigation	50,000	.....	.....		
Ridgewood	5,500	.....	1907	Stream	Sedimentation and contact beds	900,000	10 hr.	1.5	15	
Riverside	3,000	.....	1909	Water supply	Sedimentation, contact beds and sand filters	250,000	12 hr.	High		27
Roebling	2,100	.....	1909	Water supply	Sedimentation, contact beds and sand filters	130,000	10 hr.	Very high		6
Rumson	500	.....	1911	Shellfish	Sedimentation, contact beds and sand filters	.....	.....	.....		
Rutherford	7,000	.....	....	Stream	Sedimentation	800,000	8 hr.	Very little		
Sea Isle City	600	4,000	1913	Shellfish	Sedimentation and disinfection	50,000	8 hr.	Very high		
Smithville	100	.....	....	Water supply	Sedimentation and subsurface irrigation	10,000	12 hr.	....	....	
South River	2,500	.....	1909	.....	.....	.....	.....	.....	.....	
Spring Lake	600	5,500	1909	Bathing beach	Sedimentation and sea discharge	40,000	8 hr.	Very high		
Spring Lake	200	2,500	1909	Bathing beach	Sedimentation and sea discharge	18,000	7 hr.	Very high		
Spring Lake, Como	30	500	1909	Bathing beach	Sedimentation and sea discharge	10,000	9 hr.	Very high		
Ventnor City	490	7,000	1911	Shellfish	Sedimentation and disinfection	150,000	6 hr.	.....		
Vineland	5,300	.....	1901–10	Water supply	Natural sand filters and disinfection	500,000	....	Very little		7
Washington	3,600	.....	1910	Stream	Sedimentation, contact beds and sand filters	200,000	8 hr.	2	13	22
Water Witch	200	.....	1909	Shellfish	Sedimentation	10,000	8 hr.	Very high		
Westfield	6,500	.....	1907 & 13	Water supply	Sedimentation and sand filters	600,000	2 hr.	None	1.5	5
Woodbury	4,700	.....	1904	Stream	Sedimentation and tidal discharge	320,000	8 hr.	2.6	11	
Woodstown	1,700	.....	1905	Stream	Sedimentation and sand filters	99,000	4 hr.	30	150	
Red Bank	7,400	12,000	1913	Shellfish	Sedimentation and disinfection	220,000	5 hr.	31	175	
Hightstown	2,000	.....	1913	Stream	Sedimentation and land filtration	.....	.....	.....		
Salem	6,800	.....	1913	Stream	Sedimentation and disinfection	40,000	8 hr.	Very high		
Wildwood Crest	100	1,200	1913	Shellfish	Sedimentation and disinfection	.....	....	Very high		
Helmetta	700	.....	1913	Stream	Sedimentation and contact beds	.....	.....	.....		
Beverly	2,200	.....	1912	Water supply	Sedimentation and disinfection	200,000	8 hr.	Very high		4
Fairview	2,500	.....	1913	Stream	Sedimentation and contact beds	.....	.....	.....		
Hammonton	5,000	.....	....	Stream	Sedimentation, sprinkling filters and second settling	.....	....	....	....	
Gibbstown	60	.....	....	Stream	Sand seepage	.....	....	....	....	
Haworth	.....	70	1907	Water supply	Sedimentation and subsurface irrigation	6,000	....	..	....	

* Distance from sewer outlet to nearest water intake below.

An Illuminated Semaphore Signal

The illumination of the blades of semaphore signals, so as to give a position indication by night as well as by day, has been proposed many times and has been the subject of several patents. It has been tried in this country, and a signal of this class has been in use for about 2½ years in the classification yard of the Prussian State Railways at Tempelhof, near Berlin. It is said that it has given good results in ordinary weather and also during fogs, and that the operating costs are small. This signal, in its three positions, is shown in the accompanying cut. It is described by Mr. Roudolf in the "Zentralblatt der Bauverwaltung" (of Berlin).

The signal has a long blade or arm pivoted at the middle and bent to a parabolic curve. The blade consists of a long narrow mirror, while a smaller mirror curved in the opposite direction gives the back or reverse indication. In each case, a lamp placed in the focus of the parabola furnishes the illumination. A platform at the top of the signal mast serves for maintenance of mirror and lamp. The large mirror has a focal length of



SEMAPHORE SIGNAL WITH ILLUMINATED PARABOLIC BLADE; PRUSSIAN STATE RAILWAYS

4 ft., and other dimensions found to be the best by experiment. The reflecting face is coated with aluminum-bronze paint but the surface is not polished, as a diffusing action is thought best. A small parabolic reflector behind the lens serves to throw all the light upon the signal arm.

The signal is lighted with acetylene gas, fed from a steel tank at the foot of the mast, but any other form of lighting could be used. This signal is hand operated, but would be suitable also for automatic-signal work.

The signal described above is on the same principle as the parabolic illuminated semaphore signal introduced in this country some 24 years ago by J. Herschel Koyl, and used experimentally on the Lehigh Valley R.R.* This was designed to make the blade itself give combined color and position indications both by day and by night. The blade was of the usual form, pivoted at the ends, and 7 to 11 in. wide, but curved in plan, and having upon the face a 4-in. strip of silvered glass. The glass at first had vertical corrugations to distribute the light, but later it was formed with a wavy surface both vertically and horizontally.

The lamp was carried on an arm or bracket so as to be in the focus of the parabolic curve of the blade, and the side of the lamp facing the blade had the upper half of red glass (green for distant signals) and the lower half of white glass. The blade (outside of the glass strip) was painted red (or green). At night, with the arm horizontal, it showed as a beam of red (or green) light, while at the inclined position it showed as a beam of white light. During the day, the light from the sky served to illuminate it in the latter position, making it more conspicuous than the ordinary inclined red blade. For a three-position signal, the upper glass of the lamp would change from red to green with the movement of the blade.

It was stated that no trouble was expected from snow, as dry snow would not stick to the blade, while wet or frozen snow would act as a reflector. It is of interest to note the reappearance of this design in the German railway signal noted above.

*"Engineering News," Sept. 28, 1889; "Journal" of the Franklin Institute, August, 1889.

An Obstinate Railway Tunnel Fire in California

The fight against the recent fire in the Santa Margarita Tunnel of the Southern Pacific Co., located 16 miles north of San Luis Obispo, Calif., on the Coast Division, involved many interesting features. The information contained in the following account is taken from the San Francisco *Chronicle*, of Nov. 9.

The fire, which was started by tramps, was discovered at 9:30 a.m., on Sept. 17, and was abandoned two weeks later to burn itself out, after both steam and carbon dioxide had been tried in a vain effort to extinguish the flames.

The fire-fighting force numbered 400 men, of whom 77 were overcome by heat, smoke and gases, and 15 were injured by falling rock and embers. At 5 p.m., on Sept. 17, a relief train reached the tunnel, but was unable to advance far into it, because of the heat and of cave-ins.

W. R. Davis, General Manager of the Southern Pacific Co., was present in an advisory capacity, while J. M. Davis, General Superintendent, and Thomas Ahern, Division Superintendent, were in direct charge of the operations. Both ends of the tunnel, which was 1370 ft. in length, were sealed and steam was injected from locomotives at the rate of about 2700 lb. per hour for 48 hours. While of some value toward controlling the flames, the steam penetrated and dissolved the earth of the tunnel, causing numerous cave-ins.

Carbon dioxide was then tried. Fourteen 50-lb. cylinders, each capable of delivering 500 cu.ft. of CO_2 at atmospheric pressure, were exhausted into the sealed tunnel. Twenty-four such batteries were emptied into the tunnel before the seals were removed.

A crew then made its way a short distance into the bore and found the fire still burning. The tunnel was thereupon resealed and steam was again injected, but a repetition of the cave-ins caused it again to be abandoned. A large wooden chimney then was erected above the roof of the tunnel for the purpose of drawing off the

gases so that the firemen could reach the flames. Steam blown into the bore now found a vent through this chimney, and the draft or suction thus produced drew out large quantities of gas and smoke.

No permanent relief, however, was experienced. On Sept. 27 one of the seals was taken down, and carpenters endeavored to shore up the entrance, but were forced to abandon the work on account of the smoke and gas. It was soon discovered that a cave-in in the center of the tunnel had destroyed largely the effectiveness of the chimney. It was then decided to let the fire burn itself out, so the conflagration continued until about Oct. 10. Passenger traffic was maintained while the tunnel was burning by an automobile service around the tunnel. Train service was resumed through the tunnel on Nov. 7.

Flue Gas for Fire Fighting on Shipboard

Fire prevention and extinction by means of an inert gas in not a new development, but as yet its application is far from general. Carbon dioxide and sulphur dioxide gases have been used to some extent for this purpose, and now a system for purifying and distributing the flue gases from the boilers, is described by E. Kilburn Scott, A. M. Inst. C. E., in the September, 1913, issue of the "Indian and Eastern Engineer."

A typical analysis of flue gas shows its constituents to be about 80.5% nitrogen, 10% carbon dioxide, 0.5% carbon monoxide and 9% oxygen. As the presence of 15% of oxygen in the air is necessary in order to support combustion, it is evident that flue gas, which has only 9% oxygen, is inert.

In the Harker system, a pipe connected to the main funnel and also to the funnel of the donkey boiler, conducts the flue gas from the boiler furnace to the purifier which cleans and cools it by means of a fine spray of sea water. After this process, a fan driven by a de Laval turbine, delivers the clean gas to the main pipe line for distribution.

Even though the gases of the main boilers are utilized, connection to the funnel of the donkey boiler is also necessary, so that gas is available when the vessel is in port or whenever else the main boilers are out of service. A donkey boiler of ordinary size has proved entirely capable of supplying a sufficient quantity of gas. About 3000 gal. of water per hour are required to cool 90,000 cu.ft. of flue gas to a temperature of 120° F. It is estimated that about 450,000 cu.ft. of flue gas are produced by burning one ton of coal.

The fan delivers into a 6-in. galvanized-steel riveted pipe which runs fore and aft. Branch lines, controlled by valves, lead down to the bottom of the various compartments of the hold. Other lines are provided on deck for disinfecting and fumingating the passengers' and crews' quarters with a disinfectant such as sulphur dioxide injected into the system.

The procedure in the event of a severe fire on board a vessel equipped with the Harker system, would be to maintain thick fires well supplied with coal, and if forced draught is used, the supply valves which admit air to the furnace should be closed. The ventilators are closed on the compartment where the fire is and one of the hatches farthest from the gas inlet pipe, is left partly open to allow the escape of air.

This system is just as satisfactory with the flue gas which results from the burning of oil in the boiler furnaces. The exhaust from internal-combustion engines may be used as well; and the increasing application of these engines to marine work makes this an important point.

The Economics of the Water Meter*

By John Ericson†

Chicago in 1950 will have a population of 5,150,000. The consumption of water per capita has increased from 43 gal. in 1863 to 203 gal. in 1912, or about 160 gal. in 50 years. If we assume the increase in the future at half the rate of the past, we will have in 1950 a per capita consumption of 263 gal. This will require a daily pumpage of 1,350,000,000 gallons, or, in other words, the present enormous system must be more than doubled in 38 years.

Nearly 15 years ago the author commenced a series of careful investigations to determine the use and abuse of the water-supply of Chicago, and has since endeavored to point out the advisability of conservation and the restriction of the waste and leakage of our water-supply. The best and generally approved method for this purpose is the installation of water meters, a method that has proved economical and satisfactory in Europe and in those American cities where it has been adopted.

A statement showing the water meters installed during August and September, 1911, was prepared, and about a year later a careful comparison was made showing the effect on rates of the installation of these meters. They were 261 in number, of ⅝-in. to 8-in. size, and were set on all classes of service and in all parts of the city. They included saloons, foundries, railway stations, residences, laundries, buildings with hydraulic cellar drainers, hotels, factories, garages, milk depots, greenhouses, fish markets, office buildings, warehouses, apartment buildings, etc.

Where the difference was obtained, 124 premises showed an increase and 56 showed a decrease in the bills by the installation of meters. The total of the excess meter rates for six months amounts to $2885. The total of decreases, by reason of setting meters, for a period of six months, amounts to $495, making a net increase of $2390, or $4780 as the annual compensation for the setting of these meters. These figures indicate that if the placing of meters is judiciously made, irrespective of a decrease in pumpage, the city's revenues will be increased rather than diminished.

In spite of the campaign for a restriction of leakage and waste, and in spite of the economy and satisfaction that water meters have given in other cities, so much opposition to this method is met with in Chicago that only about 6% of the service pipes have so far been metered.

Designs for municipal water meters have lately been perfected in the office of the city engineer, and sample meters made from these designs are now being tried. It is expected that, as soon as these meters have proved satisfactory on trial and have been adopted as standard the installation of meters on a much larger scale will be connected.

One of the important reasons why Chicago has to pump such great quantities of water, and why there is always such urgent necessity to build additional tunnels and pumping stations, is the failure to adopt rational methods of water-waste prevention. An argument often heard is that we have an inexhaustible supply of water right at our doors and that the water should be as free and abundant as the air we breathe. If this excessive pumpage would benefit the people, there would be nothing to say about it. But, as a matter of fact, the wasted water does no one any good, and when escaping into the ground it often becomes a detriment rather than a benefit.

When it is considered that the cost for coal alone to pump the many million gallons of water in Chicago is now about $450,000 per year, it will be seen that by reducing the per capita consumption from 203 gal. to 120 gal. per day, which amount should be sufficient for any city, a saving from this item alone would amount to nearly $200,000 per year.

When we consider also the additional cost on the account of larger pipes required to carry the excessive quantities of water, other operating expenses, and the interest on cost of tunnels and pumping stations that could be delayed under

*Extract from a paper on "The Chicago Water Works," in the "Journal of the Western Society of Engineers," Chicago, October, 1913.

†City Engineer, Chicago, Ill.

proper restrictions, the saving per year would amount to many thousands of dollars more.

DISCUSSION

Horace S. Baker: A point that is made too much of in discussions on metering is the saving of expenditures for pumping and additional construction. The real advantage of saving water and checking waste is the ability to give service. At the present time, if we raise the pressure in any district, we have to greatly increase the amount of water pumped into that district. If there are faucets left open, leaky plumbing and other sources of loss, the leakage increases very rapidly with the pressure and one must keep the pumpage going up much faster than the pressure increases. If we do not restrict the waste of water we will go on forever increasing systems of pumping, but we will never give satisfactory service except at an enormously increased cost.

Water-Works Charges for Private Fire Protection

A valuable study of the principles and practice of charges for private fire protection has been made by Leonard Metcalf, consulting engineer, Boston, Mass., during the past year or two. The results of the study were summarized by Mr. Metcalf in a paper read before the 1913 Convention of the New England Water Works Association.*

Mr. Metcalf defines private fire protection as follows:

The term "private fire-protection service" is here used to cover water service furnished by the water-works to manufacturing establishments, commercial houses, and individuals, for use upon their own premises as a means of preventing fire, of limiting its spread, and of fighting it, in contradistinction to the public fire-protection service. * * * *

In private fire-protection service, insurance men are agreed that the internal pipe-distribution system, suspended from the ceilings, equipped with sprinklers which open automatically when a certain temperature is reached, constitutes the most important element, and it has been asserted that the time is not far distant when this system would be introduced in practically all commercial buildings and manufacturing establishments of magnitude. In addition to the sprinkler system within the buildings, private hydrants and standpipes, with hose connections without and within the buildings, are also used.

Cost and Savings Effected

After discussing various phases of private fire protection (summary of conclusions given at end of this article), Mr. Metcalf took up the cost of private fire protection and the savings which it effects. Tentative figures were given for a number of private fire risks.

Taking first a cotton mill valued at $1,300,000 ($400,000 for buildings and $900,000 for equipment), the cost of its private fire-protection equipment is estimated as follows:

Underground piping	$2,600
Indicator post gates, valves, check valves, hydrants, etc.	1,000
Fire pumps (2)	2,500
Suction supplies	1,000
Hose, hose houses, watchman's system and fire alarm	1,700
Automatic sprinklers and all inside piping	16,000
	$24,800
If suction reservoir has to be built, add	3,000
Total	$27,800

This is equivalent to 2.1% of cost of buildings and machinery.

For a smaller plant, valued at $170,000, the estimated cost of fire protection on the same lines is $6200 or 3.7% of the cost of the buildings and machinery. Where elevated tanks or reservoirs are required, and perhaps other special works or apparatus, the fire-protection costs might go up to 15 or 20%, but in general these costs would run from 3 to 5% of the costs of the mill properties.

Continuing, Mr. Metcalf said:

The operating charges upon such an installation as that cited in the first illustration given above might be as follows:

	Per cent.
Interest	6
Depreciation	2
Repairs	3
Supplies and miscellaneous	1½
Coal for use on Sundays and holidays	½
Extra labor on Sundays and holidays	½
Total	13½
Add administration and overhead charges	1½
Grand total upon the cost of the fire-protection system	15

This would, upon the cost of the fire equipment, amount to approximately $4170. If now the mutual insurance rate upon this property be added amounting to approximately 7c. per $100 of risk, or $910 per year, the total cost of fire-protection service and insurance, excluding the payment to be made to the water-works for the water service, would amount to $5080. Without the sprinkler service the rate upon such property in the stock insurance companies might be $1 per $100 of risk, in which case the saving effected would amount to approximately $8000 per year. If the rate given by the stock companies were less than $1 per $100 of risk, the saving would be correspondingly reduced. It is probably safe to say, however, that the equipment would be paid for by the saving in insurance in a period of not over five to six years, if nominal charge only be made by the water-works for the service rendered by it to the mill.

Water-Works Practice as to Installation and Charges

Inquiries as to actual practice sent to 2500 water-works of the United States brought only 370 replies, covering 364 towns and cities. In many cases the replies were incomplete or based on a misunderstanding of the questions.

A summary of the replies under 13 main heads is given in the paper but the practice reported is so divergent as not to warrant giving the space here which would be required to reprint the whole summary. We therefore reprint a part of it, in condensed form:

Q. 1. Maximum diameter of tap and service allowed for private fire services? Of 314 replies 79% have and 21% have no maximum. Of the number reporting maximum limits, 49% report 6 in. maximum; 24%, 8 in.; 18%, 4 in.; 6%, less than 4 in.; 2%, 12 in.; 1%, 10 in.

Q. 2. Is size of service limited by size of main tap? Broadly speaking, the replies were about equally divided upon the line of the existence or nonexistence of such a limitation [but the replies were various and vague].

Q. 3. If based on size of main, what per cent. or portion of the capacity of the main is allowed? One hundred and forty-nine replies were received. The replies indicate in general that there is no marked tendency to limit the diameter of the fire-protection service pipes in any substantial degree when taking water from pipes of diameter up to 6 or 8 in.

Q. 4. Do you require indicator post valves on private fire services? Of the 307 replies received, 66% answer "no"; 30% "yes"; 4% report no regulation.

Q. 5. If indicator post valve is used what distance from building do you require it to be set? Ninety-two replies were received; 28% report specific distance, 25% "at or near" curb, 11% determination by insurance company, 12% at street or property line, 24% vague or different standards. [Distances range from 5 to 100 ft.]

Q. 6. When indicator post valve is used, do you also require valve at main with street valve box? Of the 225 reporting approximately 93% do, and 7% do not or have varying standards.

Q. 7. Do you meter private fire services? Of the 318 reporting, 26% do; 12% do partially; 62% do not.

Q. 8. If not metered how are private fire services controlled? 163 replies specify: 36% by sealing valves and openings; 34% by inspection; 6% by bond, fine and contract cancelling; 5% by some form of bypass; 5% by separate lines; 11% by no control; 3% not classified.

Q. 9. If metered, how? Out of 82 replies, 65% use detector meters, 23% various types of meters, and 12% could not be classified.

Q. 10. Do you charge for private fire-protection service? Of the 331 replies, 48% make a charge of some kind; 51% make no charge; 1% are unclassified.

Q. 11. If charged, how is charge based? The [few and unsatisfactory] replies indicate that upon hydrants located both inside and outside of the building an annual charge per hydrant is made, upon sprinklers a charge per sprinkler head and connection, per unit area of floor space, per size of build-

*The paper will be printed in the "Journal" of the association. The study was made in behalf of a committee of the association, which included Mr. Metcalf, Emil Kuichling and Wm. C. Hawley, but the paper was the work of Mr. Metcalf alone. Information collected by Mr. Metcalf in the form of replies to circular letters to obtain water-works practice has been bound and is available for the use of members of the association in Mr. Metcalf's office, 14 Beacon St., Boston, Mass.

ing, fire risk, value of property, and charge for auxiliary connection, or "ready to serve" charge.

Q. 12. What is amount of charge? Satisfactory classification impossible.

Q. 13. Are private fire-protection charges in addition to regular rates or are they remitted if the other charges for water exceed the maximum charges for fire protection? Of the 76 replies received, 82% report the charges to be additional, and 18% in offset to the charge for water, that is "remitted."

Summary and Conclusions

Finally we give Mr. Metcalf's summing up as follows:

1. There is no standard practice today among waterworks in the United States with reference to the characeer of, or charges for, private fire-protection service.

2. The "Rules of the National Fire-Protection Association,"* relating to size and arrangement of service connections from public water-supplies to private fire-protection systems as applied to isolated and to congested city risks appear conservative and worthy of trial if the insurance companies will only leave their interpretation, for them, to an independent board or committee of competent and judicially minded fire-protection engineers, rather than to their local insurance agents, and will agree to a conservative interpretation of the right to use larger service connections than a 4-in. maximum contained in their rules.

3. While in the majority of cases 4 in. is a desirable maximum limit for the diameter of private fire-service connections or pipes, particularly in the congested or thickly built-up sections of the community, and while it is desirable that greater capacity should be gained by adding other 4-in. service-pipe connections or units rather than by increasing the diameter of the connection, it is recognized that in some cases, more particularly in large and well isolated risks, service pipes of larger diameter can safely be approved.

4. The private fire-protection service should be absolutely independent of the industrial, commercial or domestic service and be limited to use for fire-fighting purposes.

5. The private fire-protection service should be equipped with connection for pitometer readings, with valve and metered bypass, or with detector meter of some kind, for inspection and detection, or metering of consumption, resulting from leakage, waste or use of water, as local and financial considerations shall show to be expedient or necessary.

6. Past experience in different communities indicates clearly that abuse of privilege may be successfully controlled by the following methods, which may advantageously be applied successively, if the minimum cost of furnishing private fire-protection service is desired:

a. Use of seals upon hydrants, blow-offs and other gated connections, coupled with periodic inspection by water department and agents of the insurance companies.
b. Periodic inspection coupled with use of pitometer or metered bypass upon service.
c. Use of detector meters, particularly in installations where the added cost of the meter will not be burdensome.

7. The question as to whether or not charge should be made for private fire-protection service depends largely upon local conditions and circumstances. There is good ground in equity for urging, upon the one hand that no charge should be made for such service, in addition to the charge for public fire-protection service, and upon the other hand, that a moderate charge based upon the cost of the special service rendered, together with the additional cost of inspecting private fire-protection services, would not be inequitable or burdensome.

In some cases as the payments for public fire-protection service are commensurate with its cost, and probably in many other cases as a matter of expediency in encouraging the installation of private fire-protection connections and devices for the better protection of the community against hazard of fire, it is believed to be desirable that a nominal charge only should be rendered for private fire-protection service.

8. If a nominal charge only is made for private fire-protection service, it should cover:

(1) The cost of cutting into the street main and making the necessary connection from it to the property line. The insertion of additional gates at the ends of the street block upon which the service is located, if such gates are not already in place. The insertion of a gate advantageously located upon the service. The installation upon the service either of a gated bypass with small meter upon it, or of a detector meter or other device for detecting or recording flow.
(2) The cost of a system of double check valves with pet-cocks between them to test their tightness, if another source of supply which may be polluted is connected with the service, and if such a system of check valves may be counted upon under existing conditions to safely protect the public supply. If not, the two sources used should be upon independent service pipe lines.
(3) The cost of water used or lost by leakage upon the service.
(4) The cost of maintenance, depreciation and interest upon the service if the latter is not paid for by the insured when installed.
(5) The cost of maintenance, depreciation and interest upon such portion of the water-works plant as may have been necessitated by the demands of the private fire-protection service alone, and which is in excess of the capacity required for the domestic, commercial and public service, including in the latter public fire-protection service.
(6) The cost of periodic inspection, reading of meters, testing devices, etc.
(7) The cost of maintaining inspectors in large cities, whose duty it shall be to be thoroughly informed as to the location of all private fire-inspection services, to inspect them frequently and to attend all fires. In the case of smaller works, this work would naturally be done at intervals by the regular operating force, under such circumstances its cost should equitably be charged to the private fire-protection service. These charges excepting the third item, which covers the cost of the water used, should be made independently of, and in addition to the charge for the water actually used.

9. The distribution of the charge levied for private fire-protection service can perhaps most simply, directly and equitably be levied as an annual service charge for each service-pipe connection, increasing the amount of the charge with the pipe diameter.

*Those desiring these rules may address the Secretary of the National Fire Protection Association, at 87 Milk St., Boston, Mass.

NOTES FROM THE ENGINEERING SCHOOLS

University of Toronto—The twenty-fifth annual banquet of the Engineering Society of the University of Toronto, on Dec. 7, was made a celebration of the thirty-fifth anniversary of the founding of the Engineering Department, then called the School of Practical Science; incidentally the occasion was the 50th anniversary of the entrance to the University of the founder of the department and its present Dean, John Galbraith.* Among the reminiscences of his friends, one anecdote is worthy of record. It was related how at the time of the Fenian Raid, young Galbraith was out in the field with a surveying party when the call came for volunteers. Both he and his chief wanted to enlist, but only one could leave or their party would be broken up. So they decided that the best fighter ought to go and, after the day's work, they went out behind the camp to determine superiority with their fists. Galbraith won.

Columbia University—A library of highway engineering has been founded by C. H. Davis (President, National Highways Association)3 for the general use of engineers, contractors and all others interested. This library has been placed in Rooms 407 and 410 of the University Engineering Building.

A one-month graduate course in highway engineering has been arranged for road officials, chemists, engineers, contractors, etc., and is to be given between Dec. 19, 1913, and Jan. 23, 1914. Three general topics are to be covered: (1) the mining, manufacturing, testing and inspection of bituminous materials; (2) the construction of broken stone and gravel roads, and of brick, stone-block, wood-block and concrete pavements; (3) the construction and maintenance of bituminous pavements and surfaces. A second graduate course of seven weeks, Dec. 19 to Feb. 3, has been arranged covering topics (1) and (3) above and also (4) the laboratory study of bituminous road materials. A third course of eleven weeks duration, Dec. 19 to Mar. 4, has also been arranged covering topics (1), (2) and (3), and in addition (5) structural geology, soils and rocks, (6) laboratory testing of non-bituminous road materials, (7) mechanical appliances and (8) management.

*A sketch of the life of John Galbraith was printed in "Engineering News," Feb. 6, 1908, when h was President of the Canadian Society of Civil Engineers.

Ohio River Locks at Louisville

SYNOPSIS—The Ohio River is one of the most important streams of the inland navigation system of the United States, and is noted especially for its heavy coal traffic. The U. S. Government is improving the river by constructing a series of dams and locks to give a minimum depth of 9 ft. At Louisville the navigation lock is independent of the dam, being located in a canal which affords passage around "the falls." The accompanying article describes the new canal lock now being built and the proposed reconstruction of the river dam, and describes also the construction plant and methods employed.

The length of the Ohio River is nearly 1000 miles. The U. S. Government has spent several million dollars in improving the open river and in building locks and dams to maintain a uniform depth for slackwater navigation. The present project, which proposes a minimum depth of 9 ft.from Pittsburgh to Cairo, was adopted by the River and Harbor Act approved on June 25, 1910, and it was then estimated that this would require 54 dams and locks between Pittsburgh and Cairo, at a cost of approximately $63,732,000. Up to the present time, 12 dams have been completed (including those built under earlier projects), and 13 are now under construction, while plans have been prepared and appropriations made for others. This general scheme of improvement was described in ENGINEERING NEWS of Oct. 8, 1908, and one of the typical locks and dams (No. 37, at Fernbank, below Cincinnati) was described and illustrated in our issue of Mar. 4, 1909. The work is all under the direction of the Corps of Engineers, U. S. A.

At Louisville, Ky., the Ohio River has at low-water stages a series of shallows and short rapids (known as the Falls of the Ohio), so that the river is not navigable at this stage, although at high water there is a good channel for navigation. To permit vessels to pass this part of the river at low-water stages, there is a canal with locks, while across the river, at the head of the canal, is a dam (with fixed and movable portions) which maintains a proper depth of water in the canal. The dam and the navigable channel (known as the Indiana chute) have already been improved, and the present article deals more especially with the improvements on the canal and locks.

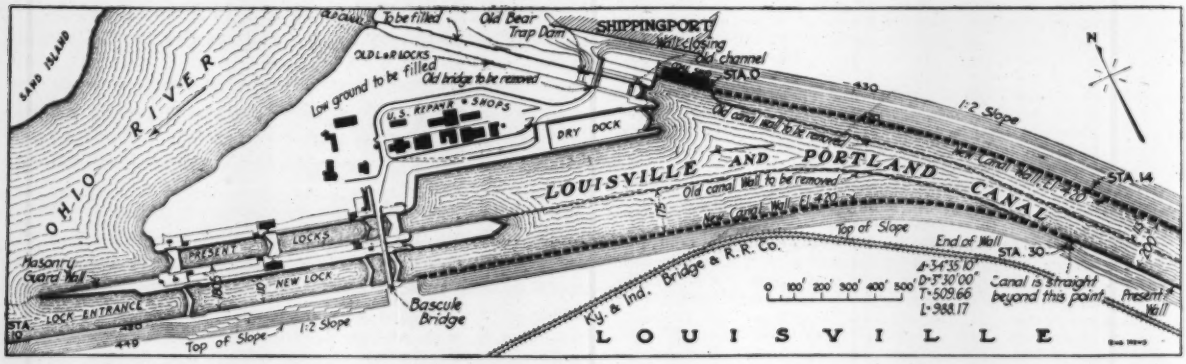


FIG. 1. PLAN OF LOCKS AND LOWER END OF THE LOUISVILLE & PORTLAND CANAL, AT LOUISVILLE, KY.; SHOWING THE NEW LOCK AND THE CANAL WIDENING

The present project for the work at Louisville was adopted in 1910 (forming part of the river improvement scheme noted above), and included the following features,

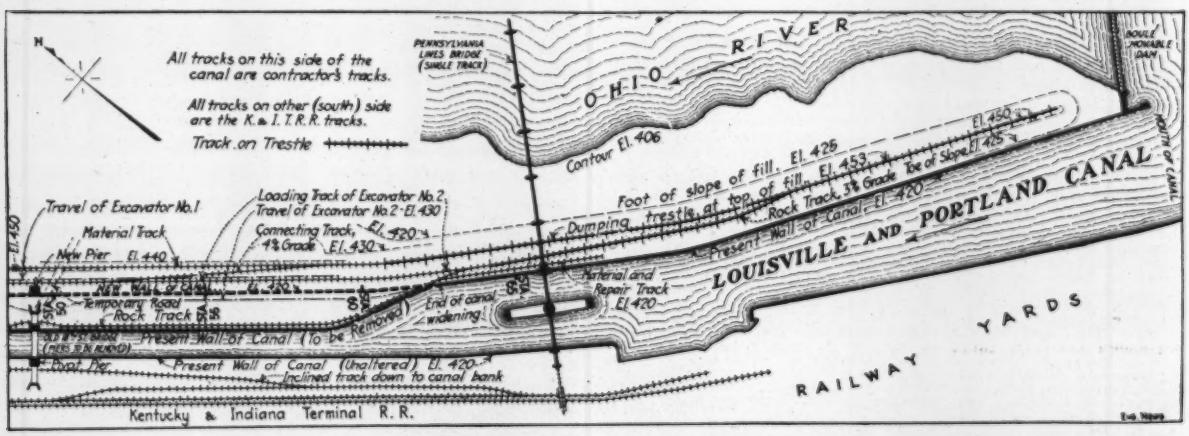

All tracks on this side of the canal are contractor's tracks.
All tracks on other (south) side are the K. & I. T. R. R. tracks.
Track on Trestle
PENNSYLVANIA LINES BRIDGE (SINGLE TRACK)
O H I O R I V E R
Contour El. 406
Foot of slope of fill, El. 425
Foot of slope of fill, El. 453
Dumping trestle at top of fill
Rock Track, 3% Grade
Toe of Slope El. 425
El. 450
Present Wall of Canal - El. 420
LOUISVILLE AND PORTLAND CANAL
Travel of Excavator No. 1
Material Track
New Pier El. 440
Loading Track of Excavator No. 2
Travel of Excavator No. 2 - El. 430
Connecting Track, El. 420
4% Grade El. 430
Temporary Road
Rock Track
End of canal widening
Material and Repair Track El. 420
Present Wall of Canal (To be Removed)
Present Wall of Canal (Unaltered) El. 420
Inclined track down to canal bank
Kentucky & Indiana Terminal R.R.
RAILWAY YARDS

FIG. 2. PLAN OF UPPER END OF LOUISVILLE & PORTLAND CANAL, SHOWING THE IMPROVEMENT WORK AND THE END OF THE OHIO RIVER DAM

with their estimated cost: (1) widening the canal to 200 ft., $936,031; (2) constructing a new lock, 110x600 ft. (parallel with the existing lock), $1,710,325; (3) creating a pool in the river above the falls with water level at 412.004 by reconstructing old portions of the dam and building new sections of the Boulé movable dam, $271,000; (4) removing rock from the basin at the head of the canal, $43,000. The total cost was to be $2,960,356. The third and fourth items have been completed, but further changes to the dam are proposed, as noted later. The dam is No. 41 in the series of locks and dams on the Ohio River.

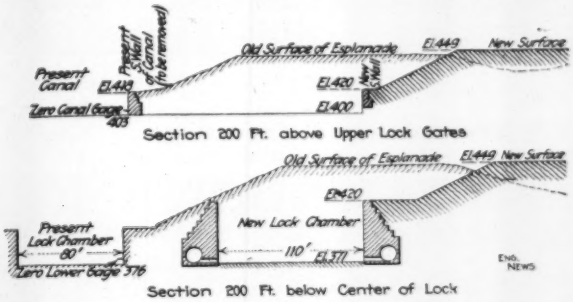


FIG. 3. CROSS-SECTIONS OF LOCK AND CANAL IMPROVEMENTS, AT LOUISVILLE, KY.

THE LOUISVILLE & PORTLAND CANAL

This canal is about two miles long, including the locks. It was built by the Louisville & Portland Canal Co., under a Kentucky charter of 1825, and was completed at the end of 1830. The U. S. Government became a stockholder in 1826, and gradually acquired all the stock and bonds. The canal was 64 to 68 ft. wide, with 3 ft. of water at low stages. It had three tandem locks with chambers 50x200 ft., and a lift of 8.66 ft. each. In 1860 the company commenced work for widening the canal to 90 ft. and building a new double-lift lock of 26-ft. lift, with two tandem chambers 80x350 ft. The depth of water was 4 ft. on the lower sill of the lower lock at the lowest stage of the river, and about 3 ft. on the upper sill of the upper lock at the same stage. This latter depth has been increased to 11 ft. by the construction of the dam, and a depth of 9 ft. on the lower sill will be provided by the construction of the next dam downstream (No. 42). These locks were opened in 1872. The basin above the locks was enlarged in 1893.

The U. S. Government assumed charge of the improvement work (and the construction of a river dam at the head of the canal) in 1868, but the company operated the canal and collected tolls until 1874, when the government assumed entire control, collecting only such tolls as were necessary for operating and maintenance expenses. In 1880, tolls were abolished entirely. In the year ending June 30, 1912, the canal carried 4834 steamboats, barges and small craft, with 944,656 short tons of freight; during the same period, 1315 vessels (carrying 298,394 tons) used the river channel.

At the head of the lock entrances is a dry dock for work on the U. S. Engineer equipment, and which is also rented for commercial work. It resembles the docks provided at other dams on the Ohio, having a pair of miter gates at the entrance, and a paved incline at the inner end on which barges, etc., can be built and repaired. Near this point is a small wharf, where coal is unloaded from barges and into wagons. Fig. 1 is a plan of the locks and the lower end of the canal. Fig. 2 is a plan of the upper end of the canal.

The old locks have long ago been abandoned and the gates removed, except the upper gates. The entrance has now been closed by a concrete wall or dam built just below the upper gates, and the channel will be filled and graded to the present ground level to form a site for repair shops and other government work. The lower entrance channel of the old locks carried the discharge from the dry dock, a culvert being built through the intervening ridge. To provide for this, a culvert 6 ft. high and 4 ft. wide, of reinforced concrete, is being built in this part of the channel, to be covered by the fill. For this purpose a coffer-dam of steel sheet piling has been built across the lower end of the lock channel.

The old locks had masonry walls, miter gates with guys from an extended quoin post, and a bear-trap controlling gate or dam. The existing locks have miter gates of the same type. New gates were built and installed by the lock force in 1912. In placing them, they were handled by a sheer-leg derrick with lines led to the hoisting engine of a government dredge boat.

The zero elevations on the river gages below and above the falls are 376.056 and 403.004 ft. (above sea level), making a difference of about 27 ft.

THE NEW LOCK

The new lock, now under construction, will have a chamber 110x600 ft., with a single lift of 30 ft., and with 11 ft. of water on the sill when the dam next below (No. 42) is completed. It is parallel with the existing double-lift lock, the distance between faces of adjacent walls being 70 ft. The walls will be carried up to elevation 422. Fig. 3 shows sections of the work at the lock and in the basin above the lock.

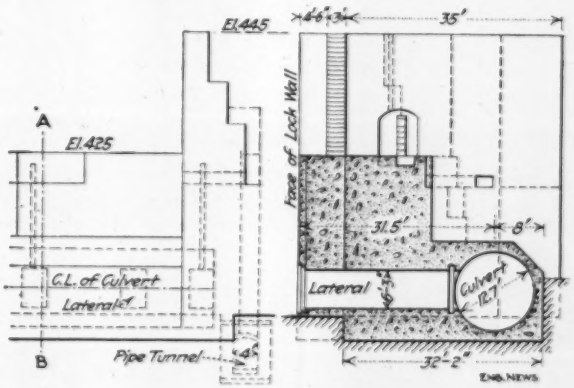


FIG. 4. LOCK WALL AND FILLING CULVERT, WITH LATERAL OPENINGS TO THE LOCK CHAMBER

For filling and emptying the lock there will be separate culverts under each side wall, with laterals opening into the lock at the bottom of the wall, there being no openings in the floor (Figs. 3 and 4). The culverts will be 13 ft. diameter, and each will have six rectangular laterals 4x6¼ ft., about 12 ft. c. to c., those from the filling culverts discharging at the gate recesses. The two filling culverts will extend from the upper end for half the

length of the lock, and the two emptying culverts will extend from the middle of the lock to the lower end.

The original plan was to equip the intakes with butterfly valves, but as it was considered that it would be difficult to control such valves properly under a head which might reach 40 ft., it has been decided to use Stoney sluice gates. Each gate will be 10x12 ft., operated by two hydraulic cylinders under a pressure of 500 lb. per sq.in., as shown in Fig. 5. There will be two gates for the filling culverts and two for the emptying culverts.

The lock gates will be of steel, of the mitering type, each leaf being operated by a horizontal operating strut connected to the ram of a hydraulic jack or cylinder, working with oil under 500 lb. pressure (Fig. 5). It was proposed at first to use gates of the vertically framed type, and designs for these were prepared. The gates of the Louisville lock, however, will be much higher than any of those built on the vertically-framed type, and the superior officers of the U. S. Engineer Corps decided that it would not be advisable to adopt this type of design. New designs have been made, therefore, for horizontally framed gates, following the general type of the miter gates for the new lock on the Mississippi River at Keokuk, Iowa.*

Construction of the New Lock

The top of the rock or shale underlying the clay overburden is nearly level throughout the work at the lock.

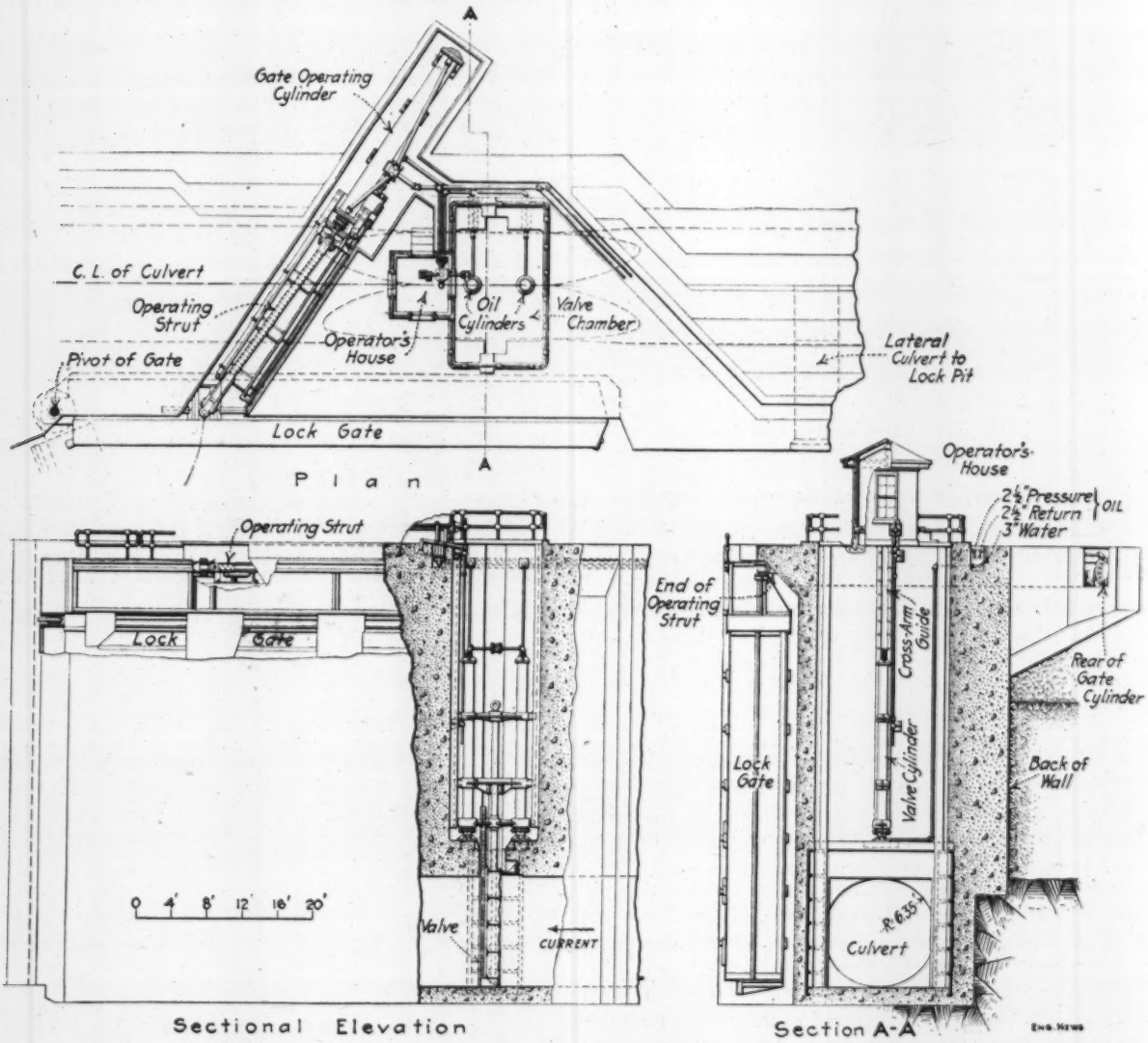


Fig. 5. Hydraulic Apparatus for Operating the Culvert Valves and Lock Gates of the New Lock at Louisville, Ky.

The face timbers of this are attached to transverse sills, forming L-shaped bents; the sills are covered with loose rock forming an anchorage to prevent the bents from tilting outward. The face is at approximately elevation 405, or 7 ft. below the pool stage in the canal and 29 ft. above zero on the river gage below the lock. The upper end of the lock pit excavation is left untouched, to serve as a coffer-dam, while a timber coffer-dam is built along the south side of the present lock entrance.

*"Engineering News," Nov. 13, 1913.

sheeted with planking. Along the old lock, the present lock wall forms the boundary, while a coffer-dam will be built to shut off the lower end from the river when the excavation has reached such depth as to require this.

The total depth of excavation is about 79 ft., of which 44 ft. is in earth and 35 ft. in rock. It was thought that the lower part of the pit would be in solid rock, requiring only a thin curtain wall. But the material proves to be loose, with many vertical seams running diagonally across the line of the lock. It is probable that a wall of gravity section will have to be built to a foundation below the floor of the lock chamber.

Fig. 6 shows the work on the lock at the end of 1912, with two channelers cutting the side of the lock pit adjacent to the present lock, and two locomotive cranes handling grab buckets. A steam shovel is at work beyond the second crane. The two buildings are on opposite sides of the present lock. The swing bridge at the right crosses the lock entrance, and as its approach has been destroyed, there is now a diversion road, entering one of the side panels of the truss. In the distance is shown the erection of the new superstructure of the bridge of the Kentucky & Indiana Bridge & R.R. Co. During the flood of last spring, the lock-pit excavation was flooded, the water reaching to within a few feet of the tops of the booms of the locomotive cranes and nearly to the level of the bridge floor.

In the rock, the sides of the cut are formed by channelers, making three successive benches of 10 ft. (for the first or top bench), 12 ft. and 13 ft. For the rock excavation in the body of the pit a deep-hole portable or wagon drill is used, putting down 4-in. holes 11 ft. deep, spaced 10 ft. in both directions. The drill handles 15-ft. drill rods, so that no change of rods or steels is required. The explosive used is No. 60 dynamite (or 60%), and averages 0.33 lb. per cu.yd. of rock. The drill averages 225 ft. per 8-hr. shift, and has a maximum record of 333 ft. The channelers average 100 sq.ft. per shift.

The earth excavation and the handling of the loose rock is done by steam shovels and by locomotive cranes with 1¼-yd. grab buckets, the material being deposited on the low ground immediately south of the lock pit. The material is loaded into 4-yd. wood side-dump narrow-gage cars which are hauled by small locomotives to the southeast corner of the pit. From this a cable and hoisting engine shifts the cars to the foot of a double-track incline of about 30% grade, or 33° with the horizontal. Each track is operated independently and its cable has a car-pusher or barney car running on rails pust inside the track rails and descending into a pit at the foot of the incline. One track is used for raising loaded cars and the other for lowering empty cars, only one car being handled at a time.

The switching cable at the bottom pulls a loaded car from the siding to the foot of the incline, just beyond the barney pit. The incline cable is then operated, bringing the barney up behind the car to push the latter to the head of the incline, where it is coupled in a train to be hauled to the dump by a small locomotive. The descending empty car is released at the bottom of the incline by the barney car descending into its pit, and the car then runs to a storage siding, from which trains are taken by locomotives to the excavators. This machine can raise loaded cars at the rate of one per minute.

Water for the various boilers is obtained from a pipe laid along the top edge of the excavation and connected with a city main. This pipe is buried below the frost line and has branches about 200 ft. apart. Each branch line passes through a heater which is fired whenever the temperature is below freezing, as the distributing pipes to the various machines cannot be covered. There has been no trouble from freezing with about 350 ft. of 1-in. distributing pipe attached to one heater, at temperatures as low as 13° F.

The Ohio River flood of last spring has caused considerable delay in the work. Not only was the work submerged for some weeks, but the excavation (about 70x1100 ft.) was filled with mud to a depth of 12 ft. When the river fell to normal stage, the surface of this mud deposit at the upper end was 5 ft. below the level of water in the canal, while at the lower end there was a fall of about 4 ft. from the bottom of the mud to the water surface. Mr. Wright, the contractor's superintendent, put three 12-in. pipe siphons at the upper end, drawing water from the lock entrance, and forming a stream

FIG. 6. EXCAVATION OF THE CHAMBER OF THE NEW LOCK AT LOUISVILLE, KY.
(The present double-lift lock is at the right, between the two lock houses.)

which washed a channel through deposit. The mud from the sides was washed into this stream by jets of water from hose.

WIDENING THE CANAL BASIN

The canal basin above the locks will be widened 175 ft. on the south side for about 2300 ft. so as to form the entrance to the new lock (as shown by Fig. 1), giving the basin a total width of 400 ft. The new side of the basin will have a concrete wall and a rockfill slope of 1 on 1½ from the ground level (at about El. 450) to the top of the wall at Elev. 420.

In doing this widening work, the old stone masonry wall was breached and a basin excavated behind it to permit dredges to enter and continue dredging in the rear of the wall for the additional width of 175 ft. This wall will be removed later, and probably by the use of derrick boats, as this will be easier than blasting and dredging. The depth of excavation includes about 40 ft. of earth and 5 ft. of rock. The excavated material is towed about 2½ miles and dumped into deep pools in the river above the falls, although a part of it is doubtless carried down the stream and may help to build up bars and obstruction. Fig. 7 shows dredges and river steamers with scows working behind the old south wall.

At one point of this widening, the tracks of the Kentucky & Indiana Terminal R.R. approach so close to the

line of excavation (Fig. 1) that it was considered desirable to build that part of the retaining wall to support the railway fill before cutting away the slope. A trench will be cut, therefore, parallel with the tracks, and the wall (about 21 ft. high) built in this for a length of about 395 ft. This trench will be excavated by means of a derrick and orange-peel bucket.

Widening the Louisville & Portland Canal

The canal itself will be widened along its north (or island) side for its entire length (as shown in Figs. 1 and

Fig. 7. Widening the West End of the Louisville & Portland Canal, at Louisville, Ky.

(The dredges and steamers are behind the old canal wall, which will be removed later. On the opposite side is the old north wall and bank, which will be removed later.)

2). The property on the south (or city) side is too valuable to be taken for this purpose. This will give a width of 200 ft., instead of the present 85 ft., for 6200 ft. from 15th to 26th Sts. The old walls on both sides of the canal are of stone masonry, as noted above. The new walls will be of concrete, on a rock foundation level with the bed of the canal. The walls will have a vertical face, and a top thickness of 4 ft. at Elev. 420 (8 ft. above the surface of the pool); the back will be offset or stepped so as to give approximately a thickness of 50% of the height at any point. The new north side of the canal will be given a slope of 1 on 2 from the top of the bank (at about 450) to the top of the wall at 420. The slope will be sodded, this work being done by day labor by the local force in charge of the canal and locks.

The contract for this widening includes the following work: (1) a new concrete canal wall and the removal of the old masonry wall; (2) a concrete pier for the new bridge; (3) a concrete foundation for the section of the emergency dam between the old and new north walls of the canal; (4) the extension of the discharge culvert for the dry dock; (5) drainage culverts under the canal embankment; and (6) the construction of a retaining wall across the old locks.

The contractor is required to maintain communication over the 18th St. bridge for foot-passenger and wagon traffic. The discharge culvert and the wall closing the old locks have been noted above. The entire work embraces some 770,000 cu.yd. of earth excavation, 205,000 cu.yd. of rock excavation, 490 cu.yd. of reinforced concrete, 16,950 cu.yd. of plain concrete, 48,300 sq.ft. of channeling, and 12,200 sq.yd. of macadam roadway. The work is to be completed in three years.

The contract provides that the material excavated is to be disposed of in a levee extending from 10th to 26th Sts., and in filling the old locks. As practically all the material excavated will be used on the ground it is necessarily a job of excavation in the dry. The old canal wall is a 4-ft. stone wall laid in cement mortar with wee holes at irregular intervals. There is a leaky joint b tween the rock and the wall, the canal at its ordinary sta being from 2 to 6 ft. above the surface of the rock. B hind the wall is a fill of some 15 to 20 ft. of loose roc which would be of no value in holding out the wate Therefore, all the material back of the wall above th natural rock is being removed and an 18-in. concrete wal is being constructed to a height of 1 ft. above the wate line.

To accomplish this, forms are placed and mud is banked behind these to hold the water. The water is then allowed to rise to the height of the canal and the concrete is placed in still water. Up to the present time some 300 ft. of the wall has been treated in this manner with apparent success. In excavating the rock, it is proposed to leave some 15 ft. north of the wall to be dredged out later. Here trouble may be experienced with water coming through the seams between the ledges of rock, and the method of handling this will depend upon the amount of water encountered.

A contour map on a scale of 40 ft. to the inch was prepared for reference in forming a working plan and deciding upon the equipment to be used. The plant is composed of the following machines: 2 Lidgerwood-Crawford drag-line excavators, with 70-ft. boom, 16-ft. turntable and 2-yd. Page bucket; a Marion steam shovel with 2½-yd. dipper; 2 Thew steam shovels; 4 Porter contractors' locomotives with cylinders 14x20 in.; 24 Western air-dump cars with wooden bodies of 24-yd. capacity; an Ingersoll-Rand channeler, and an Ingersoll-Rand wagon drill. It may be found necessary later to add another drill and channeler to this plant.

The working plan as shown is for drag-line excavator No. 1 to start at Sta. 59 and work west making the levee. At present this machine is at Sta. 50 and is being helped from Sta. 40 west by the two Thew shovels and teams. Drag-line excavator No. 2 was to follow No. 1, loading all the surplus earth on cars on track, as shown, at Elev. 430, 40 ft. north of the new wall. This will keep the digger in the dry and no time will be lost due to failure of pumps; only one track will be necessary and this can be kept in good shape at small cost, thus preventing derailments, and no time will be lost moving the machine as only one cut is necessary. It is believed that these three reasons will offset the larger output of the steam shovel.

As the shipment of the engine for drag-line excavator No. 2 was delayed, some 32,000 cu.yd. were removed with the two Thew shovels and teams from Sta. 59 to 55, and some 34,000 cu.yd. with the Marion shovel and cars from Sta. 58 to 50. The rock will be handled with the Marion shovel. The cross-sections in Fig. 7 explain the method of working and the positions of the tracks shown in Fig. 2.

The track layout as shown on the plan may be explained as follows: The loading track for drag-line excavator No. 2 is to be used for a loading track and for the concrete plant. The earth on which it stands will be used for backfill behind the wall. The material track on top of the embankment will be used for material for concrete and the macadam roadway, for any extra earth that may be required, for storage of the plant during flood periods, and for the loading track for excavator No.

1 at the 18th St. bridge. The rock track along the wall is the main rock track and will be carried the entire length of the canal, branching off where necessary for loading tracks.

The approach trestle is being constructed with the track just outside the slope, so that the entire slope may be made and this track kept clear. The unloading track along the wall from Sta. 62 to 68 is for unloading material from barges and for a repair track. This same general track scheme will hold for the west end, a track being run through a break in the fill along the north toe of slope from the loading track for excavator No. 2 to a trestle at the west end. This trestle will be filled and the track thrown to complete the fill in the old locks.

A problem presented itself at the 18th St. bridge, for at no time was traffic to be suspended. The present bridge has a swing span over the canal and a 40-ft. plate-girder span north of the canal. As shown on the plan the north abutment was replaced by a timber bent and traffic turned to the west over a timber trestle. The abutment is now

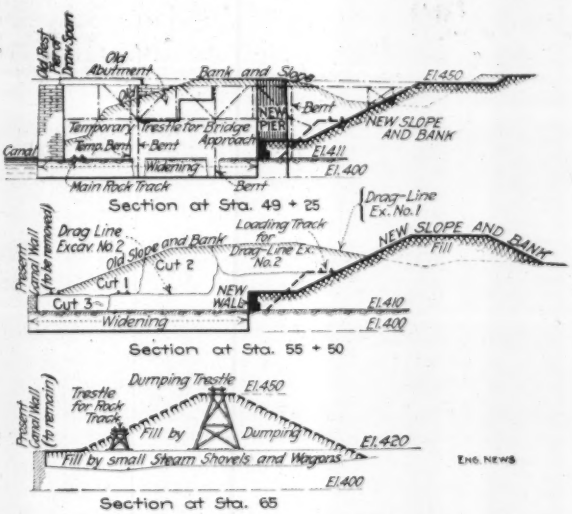


FIG. 8. CROSS-SECTIONS OF THE WIDENING WORK ON THE EAST END OF THE LOUISVILLE & PORTLAND CANAL; LOUISVILLE, KY.

being removed with drag-line excavator No. 1, used as a derrick, all the face stones being hauled on wagons to the south berm where they are required to be deposited. This excavator will then excavate to rock, loading the surplus on cars to be run east on the material track. Then three I-beam spans will be placed on timber bents and some 30 ft. of wooden trestle will be constructed from the plate girder to the new levee. This will maintain traffic at all times and give ample clearance for the plant.

The discharge culvert from the dry dock is some 20 ft. below the surface, in very wet mud deposited by the Ohio River. Here 20-ft. Lackawanna steel sheet piling is being used for a coffer-dam at the river and for sheeting some 200 ft. back from the river. The piles are being driven with a 4800-lb. Monarch hammer. The upper end of the ditch will be sheeted with wood. However, with careful work little trouble is anticipated.

BRIDGES

There are three bridges over the canal; the Pennsylvania Lines bridge and the 18th St. bridge at the upper end, and the 28th St. bridge near the lock. The first of these extends across the Ohio River and has a 262-ft. swing span (giving two 104-ft. openings) over a part of the canal which is already widened. The government will require a clear opening of at least 200 ft., and the railway company has planned to replace the swing bridge by a cable-operated lift span. The entire bridge (which is an old one composed largely of Fink-truss deck spans) will be rebuilt probably within a few years. At 18th St., there is a swing bridge 180 ft. long, with one span of 82 ft. covering the canal, and having its pivot pier on the south side of the canal. This will be replaced by a vertical lift bridge of the Strauss lever-balanced type, with a span of 200 ft. The lift will be 40 ft., giving 60 ft. headway, which is sufficient for all river steamers. At 28th St., there will be a new swing bridge 275 ft. long, having its pier between the locks and the span swinging over both the lock entrances.

EMERGENCY DAM

Near the lower end of the canal above the basin, and at its normal width of 200 ft. will be built an emergency dam of the collapsible type, which normally will lie at the bottom of the channel. This will be of the Boulé type, having pivoted frames which fall laterally. The frames are pivoted at the foot and the head of each frame (when

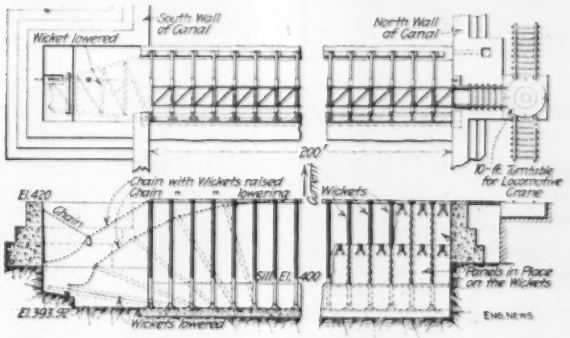


FIG. 9. EMERGENCY MOVABLE DAM (BOULÉ TYPE) FOR THE LOUISVILLE & PORTLAND CANAL; LOUISVILLE, KY.

lowered) rests upon the next frame, in approximately horizontal position. This dam is shown in Fig. 9.

The wickets or frames are raised successively by a continuous chain operated by a crab or hoist on the wall. Steel panels to close the spaces between the wickets are set in place by a locomotive crane (traveling on a track carried by the wickets) or by a derrick boat. The sill elevation (bottom of canal) is 400, and the top of the concrete floor carrying the shoes of the wicket is at elevation 394, so that the wickets when lowered lie below the level of the bottom of the canal.

This dam will be used to close the canal in case of any accident to the lock gates, and it could be raised and closed probably in two or three hours.

OHIO RIVER DAM

As mentioned already, the channel of the river is crossed by a combined fixed and movable dam, which has been built and altered at various times. This is Ohio River dam No. 41. At the present time it comprises the

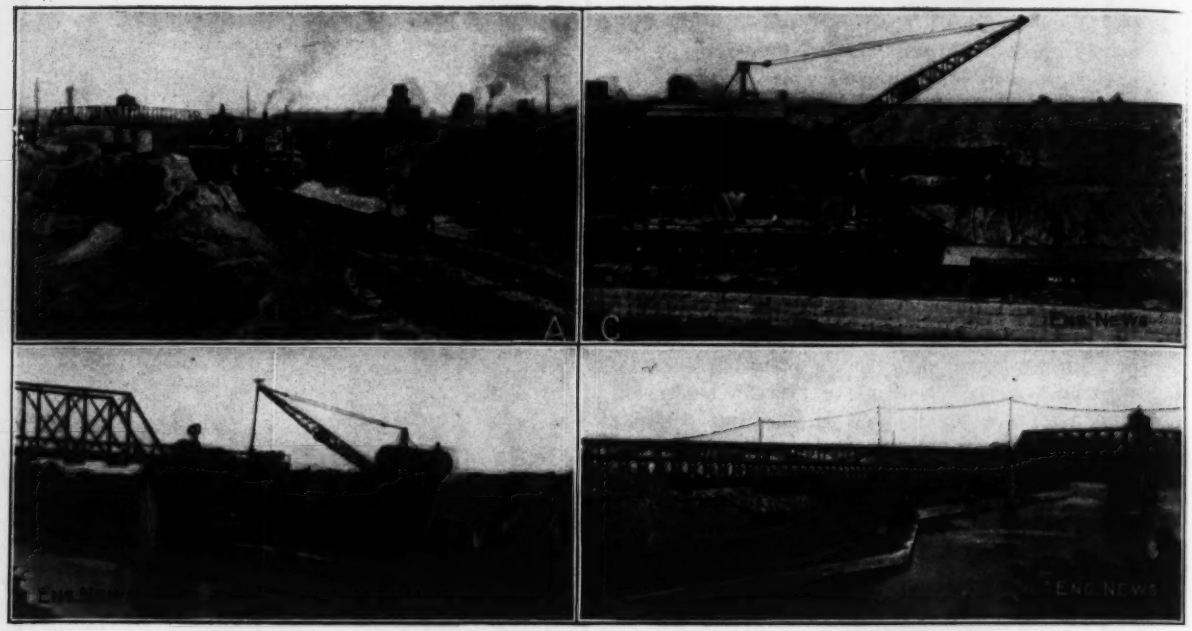


FIG. 10. WIDENING THE LOUISVILLE & PORTLAND CANAL; LOUISVILLE, KY.

A. Sept. 2, 1913. Looking east from the 18th St. bridge, showing the draw-span of the Pennsylvania Lines bridge. The steam shovel is excavating behind the old masonry wall, and beyond it is one of the drag-line scrapers, on higher ground. The steamer is in the canal.

B. Aug. 28, 1913. Drag-line excavator No. 1 at the 18th St. bridge. This shows the north rest pier and approach span of the swing bridge.

C. Aug. 28, 1913. Steam shovel and drag-line excavator No. 2 at Sta. 54. The former is working westward behind the old canal wall. The latter is working eastward.

D. Aug. 28, 1913. Work at the east end of the widening, looking eastward. This shows the swing span and Fink-truss spans of the Pennsylvania Lines bridge, with the dumping trestle for forming the new bank of the widened canal. The widening begins at the point where the canal now becomes narrow, just in front of the bridge.

following parts: 636 ft. of Boulé movable dam extending from the head of the canal; 1820 ft. of submerged concrete weir (mainly diagonal to the channel), 1427 ft. of Boulé dam (including piers), 649 ft. of Chanoine dam for the navigable pass, and 576 ft. of fixed dam extending to the Indiana shore. The end of the first section of the Boulé dam is shown in Fig. 2.

A further improvement proposed by Major Oakes is to raise the level of the dam 6 ft. This would raise the present pool level to 418 ft., and would back up the water sufficiently to allow of omitting the proposed dam and lock at Madison, Ind., about 50 miles upstream. This is dam No. 40, and its elimination would effect a saving of about $1,000,000, besides improving navigation by giving a longer stretch of open river. This stretch would be some 74 miles in length from dam No. 39 at Florence, Ind., to No. 41 at Louisville.

To effect this improvement various types of dam construction have been proposed. Perhaps the most promising of these provides for a concrete dam with a series of arched openings and controlling gates (similar to the Mississippi River dam at Keokuk), and having a section of collapsible dam of the Chanoine type at the navigable pass to provide for navigation (at high water) and river regulation.

The work at the lock is being built to such an elevation as to allow for this future raising of the water level above it.

ENGINEERS AND CONTRACTORS

The Louisville work is under the direction of Major J. C. Oakes, Corps of Engineers, U. S. Army, who is in charge of all the Ohio River improvements from Cincinnati to Cairo. F. I. Louckes and R. A. Strecker are Assistant and Junior U. S. Engineers on the canal and lock.

The contract for the new lock was let to the Ohio River Contract Co., of Evansville, Ind., in February, 1911. It includes widening the canal and constructing guide walls for about 2700 ft. east from the head of the lock, and forming the new lock entrance for about 1000 ft. west from the lower end of the lock. C. H. Wright is superintendent in charge for this company. The contract for the widening of the canal proper and the improvement at its upper end was let in April, 1913, to the Henry Bickel Co., of Louisville, Ky. This company is represented by Jacob Bickel, superintendent, Theo. B. Bickel, assistant superintendent, and A. G. Butler, engineer. Active work on the excavation is now in progress on both contracts, and it is expected to have the new lock and the canal improvement completed by 1916.

For drawings and information regarding the work we are indebted to Major Oakes, Mr. Butler and Mr. Wright.

⁂

"Dry Farmers Plan Waterway from Source of Missouri River to Texas" is the headline above a report of the recent international Dry Farming Congress at Tulsa, Okla., in the "St. Louis Globe-Democrat." The item states that a resolution was adopted:

Petitioning Congress to employ the machinery used in building the Panama Canal in the construction of a drainage canal from the headwaters of the Missouri River in the Northwest to the Texas Panhandle. Such a canal, it is claimed, would divert the flood water of that region to practical irrigation purposes and reclaim many millions of acres of arid lands.

The air-line distance between the points named is considerably over 1000 miles. Inspection of a map of the United States, however, shows that such an air line would follow the summits of the Rocky Mountain range for most of the distance. Even if the canal were swept around eastward through western Nebraska and Kansas, crossing the valleys of half a dozen great rivers at right angles, it would still have to run up and down hill in order to reach its destination and even a dry farmer should know the difficulty in making water run uphill.

EDITORIALS

By the recent employment of several engineers, the Federal Public Health Service has stepped into line with a number of our most progressive state and municipal health departments. This is highly desirable, not because it thus follows state and local example but because the Federal Health Service, in its recently enlarged field, has been taking up investigations of water-supply, sewage disposal and water pollution, matters for which engineers are or should be almost wholly responsible.

⁂

Examinations as a means of determining the fitness of candidates for executive offices in the municipal service were discussed and vigorously advocated at the recent Boston meeting of the National Civil Service Reform League. Lewis H. Van Dusen, member of the Philadelphia Civil Service Commission, read a paper designed to show "how in that city the merit system is expeditiously equipping a new department involving 140 positions, all of which, with less than a dozen exceptions, are of a technical engineering character ranging from tracer at $600 a year to chief engineer at $6000 a year, and all coming within the competitive class of the classified service, with the exception of three positions exempted from competition by act of Assembly."

Supplementing this paper was one by Lieut. James Reed, assistant director of the Department of Public Works of Philadelphia, on "How the Selection and Retention of Experts Has Resulted in Taking Contracts out of Politics in Philadelphia." Whatever one may feel as to some of the limitations of competitive examinations for filling the higher engineering positions, there is certainly much to be said in the favor of such examinations, honestly conducted and with honest use made of the results obtained.

⁂

Unintentional Suicide in Blasting

Forcibly ramming a stick of dynamite into a blast hole in which it had become lodged, was found to be bad practice by two men so engaged. While loading drill holes for blasting, at Point Ann, Ont., on Dec. 1, according to a press dispatch, a stick of dynamite became fast in a hole when part way down. In an endeavor to force it down, there was an explosion which severely injured the two men who had been inviting disaster.

Accidents are continually happening to a certain class of men who seem to have absolutely no sense of responsibility. Such men are gamblers and their gambling instinct is based, in equal proportions, upon laziness and irresponsibility. Except in isolated instances, every man who places himself between two uncoupled cars, chips castings without donning goggles, or carelessly handles dangerous explosives, automatically appoints himself to this class.

In another part of this issue we publish some rules for misfires in blasting. These rules were prepared and are recommended by men competent to discuss the subject; and we urge all our readers who are responsible for blasting operations to read this article and to impart to their subordinates any rules of caution gleaned therefrom.

The operation which precipitated the accident at Point Ann is of the same class as cleaning holes which have missed fire. It is conceivable that in some cases it might be permissible to pick out the explosive; but, if in loading a hole the charge (or any part of the charge) is seriously obstructed, the cheapest and best way to remove it is by the force of its own explosion.

⁂

Efficiency-Engineering Achievements in the Railway Service

Every little while one sees in the public prints some renewed reference to the claim made some years ago that the railways of the country could save a million dollars a day in their operating expenses if they would only adopt the methods of so called "efficiency engineering."

We do not here propose to renew the discussion over railway-operating methods and the reasons why the railways cannot adopt in full detail all the systems of economic production which are applicable to manufacturing industries, in which thousands of employees are concentrated in one establishment and are engaged in strictly repetitive processes. It does seem worth while, however, to present here some interesting statistics which have just been presented to the Interstate Commerce Commission in connection with the appeal of the railways east of Chicago for permission to advance their freight rates by 5%. These statistics compare the operating results of United States railways in 1903 and in 1912, and show some of the advancement that has been made in efficiency during this nine-year period. The average freight-train load in 1903 was 391 tons; in 1912, it was 510 tons, an increase of 119 tons in the nine-year period. In order to haul these heavier freight trains the size of locomotives has been increased. The average locomotive in use in 1903 had a maximum tractive power of 22,800 lb.; in 1912, this had been raised to 30,500 lb. The increase in the freight-train load was gained not only by hauling a larger number of cars, but by increasing the capacity of the average freight car and also its average lading. In 1903, the capacity of the average freight car was a little less than 31 tons; the present freight car has an average capacity of 39½ tons. In 1903, the average freight-car lading was 19 tons; in 1912, this had been raised to nearly 23 tons. The average number of cars in the freight train of 1903 was 30.3 cars. This has now been raised to 34 cars. While the average freight train in 1903 contained 20.7 loaded cars, in 1912 it contained 22.4 cars.

It is especially noteworthy that these increases in the lading of freight cars and freight trains have not been accomplished merely by systematizing the work, but by enormous investments in roadway, rolling stock and

equipment to enable these larger units to be handled. It is stated that the forty-nine great railway companies operating east of Chicago, which are now appealing for permission to advance their rates as above noted, expended during the last ten years an average of $200,000,000 per year on the improvement of their roadbed and equipment. There are cases, not a few, where the expenditure during the last ten years in the improvement of a railway's property has considerably exceeded the entire amount that was originally spent on the railway's construction.

Wireless Telegraphy for Railway Trains

Wide publicity has been given to the recent experimental installation on the Lackawanna R.R. of a wireless-telegraph equipment on its limited train between New York and Buffalo. The possibility of operating a wireless telegraph on a moving railway train, however, has been demonstrated by previous experiments, and the utility of the application is yet to be demonstrated. Of course, it is possible by this method to distribute bulletins of current happenings, stock-market quotations, etc., to the passengers on a limited express; but while such novelties may serve to attract attention to the advertisements of the passenger department, it is doubtful if they justify the expense of equipping a train with a wireless outfit and paying the salary of an operator. Railway profits have been frittered away too much by extravagances of this sort in the past.

The question of most interest, to the public at least, regarding wireless telegraphy on trains is the possibility of its use in connection with train movements to diminish the risk of collisions. On superficial observation it might appear to be a great advantage for the train dispatcher at a terminal to be able to instantly communicate with any of his trains wherever they are on the road. There are train dispatchers who can recall instances in their own experience when they knew that two trains were speeding toward a certain collision but were powerless to warn them of the danger.

Let us suppose, for the sake of argument, that a railway company were to equip its trains with wireless telegraphy so that the train dispatcher could at any and all times warn any train anywhere on the road. That would mean, of course, that every train on the line, freight trains and work trains as well as passenger, would have to carry a wireless-telegraph outfit and a wireless-telegraph operator. There might be some difficulty in equipping a light locomotive running over the road, for example, with wireless; but passing that for a moment, consider what the risk would be of collision if this were to be the sole reliance for communication. With all the advances that have been made in wireless telegraphy, communication is still more or less uncertain, even with the powerful equipment used on shipboard and at large permanent stations. Moreover, the jumble of confusing sounds in a wireless-telegraph message has been by no means eliminated with all the progress made in tuning, etc. There would always be a good deal of risk, therefore, that a message sent by the dispatcher to a train might be misread and misunderstood, or on the other hand conditions might be such that he would be unable to communicate with the train at all. It is rather significant that on the second day the Lackawanna Limited train was run with its wireless equipment, newspaper dispatches stated that the apparatus was more or less disabled, a generator having been burned out.

All these objections, however, do not go to the root of the reason why the wireless telegraph on railway trains is not an important advance for railway safety. The inherent defect in our American system of operating trains by telegraphic train orders, whether the telegraphic message be sent over a wire or through the air, is that the safety of the train is dependent entirely upon the train dispatcher. As all the trains operating over a busy railway division are in charge of one man, there will come a time sooner or later when a mistake will be made, either by the dispatcher himself or in the chain of transmission from the dispatcher through the operator to the conductor and engineer, and two trains will come together. The history of American railroading contains hundreds of such occurrences. We pay every year a heavy toll in deaths and injuries of passengers and employees upon railways who still adhere to this antiquated system.

If this old system were to continue in use, it is possible that the introduction of wireless telegraphy on trains might in some instances save collisions when the trains would otherwise be beyond reach, but the probabilities are that the errors and difficulties in the operation of such an uncertain system of communication would cause many more accidents than it would prevent.

It is significant that the reports of the use of the wireless telegraph on the Lackawanna did not impress English railway officials as of particular importance. The New York *Times* of Nov. 24 quoted an official of the London & Northwestern Ry. as saying:

> The report of the successful Lackawanna experiment is possibly of far reaching importance in America; but under the present method of operation here we would not gain anything, even if moving trains could be in constant wireless communication with the stations. There is never any need here to tell an engine driver how he is to go. All trains are controlled through the signal towers.

The General Manager of the British Marconi Co. himself, when interviewed, said: "I do not believe that the wireless equipment of trains will come generally in the immediate future, partly on account of its great cost and partly because at present there is no apparatus that is reliable enough under the difficult working conditions of swiftly moving trains to justify general adoption by the railroads."

Inert Gases for Fighting Fire at Sea

Adequate methods for promptly extinguishing fires on shipboard are as important as are provisions against sinking in the event of a collision. This fact has been emphasized by the recent series of marine fires. The worst of these and, in fact, the worst marine disaster since the loss of the "Titanic," was the burning of the Uranium Line steamship "Volturno," on Oct. 9, with a loss of about 150 of her passengers and crew.

Still more recently the Royal Dutch West India steamship "Jan Van Nassau" was only a few days out from Amsterdam, Holland, when a fire was discovered in the coal bunkers. The fire-fighting apparatus of the ship was of little avail and the flames spread to the cargo compartments. The vessel was turned to the nearest land and four days later reached St. Michaels, West Indies,

where the fire was extinguished after losing 800 tons of freight, and most of the coal in the bunkers.

On Nov. 12 a fire was discovered in the cotton cargo of the Spanish steamship "Balmes," bound from Galveston and Havana to Cadiz, Spain. In response to wireless calls for assistance, the "Pannonia," of the Cunard Line hastened to the scene and took off the 103 passengers of the burning vessel; the officers and crew elected to remain at their posts. The "Pannonia" convoyed the "Balmes" to Bermuda, where the latter, on Nov. 16, was towed by tugs into St. George's harbor, after a valiant but unavailing fight against the flames. The hatches were then lifted and water was pumped into the hold until the fire was drowned.

A still more recent instance of fire at sea was reported on Nov. 19, when a burning vessel was sighted about 15 miles out in the English Channel off Ventnor, Isle of Wight. Examination showed her to be the steamship "Scotsdyke," of Glasgow. She had been abandoned by her crew.

These disasters and others of a similar nature, which might be cited, point to the need for better methods of fighting fire on shipboard than are at present in use. Flooding the hold with water is effective as far as eventually extinguishing the fire is concerned, but it has several disadvantages. Water consumes a long time in percolating through a closely packed cargo; in contact with oxygen and a mass of incandescent matter (such as burning coal, in the event of a fire in the coal bunkers), water gas is formed; the water may swell a part of the cargo not on fire, causing the possible straining of the framing of the ship.

Closing the hatches for the purpose of vitiating the air and thereby choking the flames is not a satisfactory measure because it is impossible to make a tight joint.

The blanketing effect of inert gases to extinguish fires has been tried to some extent in Europe but is little known in the United States. Sulphur dioxide, which results from the combustion of sulphur, has been used for this purpose in what is known as the Clayton system; but it is better adapted to fumigation than to fire extinction. Chemically, its action is disastrous as sulphuric acid results from its contact with moisture and oxygen. The fire-fighting efficiency of sulphur dioxide depends upon the amount of sulphur available and upon the rapidity with which it can be burned.

Carbon tetrachloride, used in numerous hand fire extinguishers, is a liquid which, in the presence of heat, is converted into a heavy, inert gas. It has been tried experimentally with success in the United States navy. Its weight, which is more than five times that of air, makes it very effective, as it lies closely around the fire, smothering it.

Carbon dioxide also has proven efficient as an extinguisher; but the fact that it must be kept bottled under great pressure makes its transportation in bulk something of a menace. Some years ago this matter was investigated by the head of a large steamship line in this country but was abandoned when he learned that in order to secure full protection for vessels of about 4000 tons displacement, 250 fifty-pound cylinders of the liquefied gas would have to be carried by each ship. In the Gronwald system, in Europe, large quantities of pure carbon dioxide are stored under great pressure, in steel bottles, and in time of fire, the gas is projected by its own pressure into the cargo.

The use of the flue gases from the boilers to extinguish flames has been suggested, but has only recently been developed. In another part of this issue we publish an abstract of an article by E. Kilburn Scott, which describes the Harker system. The great advantage of the flue-gas system above the others considered, is the ease with which the gas is obtained. In time of fire immense quantities of gas are required, not alone to fill the burning compartments but to compensate for the continual leakage as well. The fact that the flue gas can be utilized whenever required, and without affecting the operation of the ship as is the case when steam is blown into the hold, is a great advantage.

This system, of course, necessitates a certain amount of apparatus, of which the principal items include a combined gas washer and cooler, a distributing fan, a main header running fore and aft, and branch pipe lines to the bottom of the various compartments. In port, this pipe system could be utilized to fumigate the passengers' quarters or the hold, by admitting a disinfectant into the system.

The Harker system would occupy a certain amount of space; if, however, its installation contributed appreciably to the safety of the vessel, it would be space well used. The system appears to merit serious consideration.

A Remarkable Survival of the Inclined Plane

Every engineer who knows something of the history of railway development will follow with great interest the paper published in this issue, by Jos. M. Ward, describing the reconstruction of the famous old inclined plane at Mahanoy, Penn., over which a large part of the coal traffic of the Philadelphia & Reading Ry. system is handled. It will be a surprise to many engineers, doubtless, that there still remains in use under such conditions an example of the old inclined-plane system of railway operation, which once played so large a part in railway development.

It is interesting to recall the reasons why to the railway builders of the '30's and the '40's, in the last century, the inclined plane was very important. The locomotive as originally developed and during all its early history, was notably deficient in hauling power. It seems simple and self-evident to the engineer of the present day that the tractive power of a locomotive is proportionate to the weight on its driving wheels. We can hardly appreciate how impossible it seemed to engineers a century ago that any considerable tractive power could be obtained by a locomotive running on smooth rails.

Many of the early inventors in the locomotive field provided a rack rail to give their locomotives sufficient hauling power. The curious development of the "atmospheric railway," over which trains were hauled by a piston traveling in a tube into which compressed air was forced, was due to the idea that locomotives could not obtain sufficient traction with their driving wheels running on the smooth rails over which the car wheels rolled.

It is, of course, well known that the railway long antedates the locomotive; and that the real beginning of the railway as a great industrial and economic agency only began in 1825, when George Stephenson's famous test of the "Rocket" was made. What most impressed engi-

neers in the successful trials of the "Rocket" was not so much the speed attained as the fact that the locomotive was able to exert such large tractive power when running on smooth rails.

The "Rocket," however, and the locomotives which followed it during several decades were mere toy machines measured by our present-day standards. In fact, no great increase of locomotive weight was possible so long as the tracks were laid with wrought-iron rails. It was necessary also to distribute the locomotive load over a considerable number of driving wheels to obtain great tractive power. As our older readers are aware, it was not until the closing decade of the last century that the steel rail entirely supplanted the iron rail and it was well past the middle of the last century before the use of locomotives with more than four driving wheels became at all common.

Under these conditions it can readily be seen that the railway builders of the '30's and '40's and '50's faced a very difficult problem when they attempted to locate a railway in rough mountainous country, requiring the use of steep grades. It was, of course, well understood at that day that where topography permitted, development of the line would enable an elevation to be surmounted without the use of steep gradients. Here again, however, the locomotive of that day set limiting conditions. So deficient in boiler capacity was it that on any long 1% or 2% grade, such as would be required to surmount a high elevation, the steam pressure was apt to run down before the end of long run up the grade.

With a clear understanding of these conditions, it may be understood how important an adjunct to the railway builders of those early days was the inclined plane. The rope-making industry was an ancient art, well established everywhere by reason of the use of ropes and cables for shipping purposes. The mining industry also was well enough developed so that winding engines of large power were easily obtainable.

When, therefore, the railway locating engineer had to surmount a considerable height in order to cross from one valley to another, for example, it was comparatively easy, simple and inexpensive to build an inclined plane, place a winding engine at the summit and arrange to haul trains up the plane and let them down as they arrived. The short light trains and thin traffic of the day all tended to favor this mode of operation.

It was even a time-saving operation, for all the operations of detaching the locomotive, switching the train into position and hauling it up the plane were gone through in less time than would have been necessary if the summit had been surmounted in the ordinary manner by constructing a long stretch of developed line on the maximum grade.

Doubtless the most extended and most famous use of the inclined plane was to surmount the summit of the Alleghenies in carrying the first railway line across the State of Pennsylvania. This was rightly regarded as one of the greatest engineering feats of its day. It was the increase in the volume of traffic more than any other cause which eventually brought about the abandonment of inclined planes, most of which have been out of use so long that their importance in connection with railway location has been well nigh forgotten by the present generation of engineers. It is, therefore, a most interesting and remarkable fact that when the Philadelphia & Reading Ry. Co. had to face the problem, some three years ago, of abandoning its Mahanoy Plane or rebuilding it to increase its capacity it chose the latter alternative as the result of a careful engineering investigation.

This result will doubtless be a surprise to most railway engineers. It has been taken for granted, probably, that the old Mahanoy Plane had been continued in use long after it had become obsolete, simply because the company did not wish to make the large investment necessary to build a long developed line to replace the plane. The fact that there is still a place in railway operation where the inclined plane can show an economic advantage over the locomotive is indeed a fact well worth recording.

We recall only two instances in railway-construction work during the past twenty years where the inclined plane has been introduced. One of these is the railway line which was built a number of years ago under the auspices of the British Government extending from the east coast of Africa inland to the central African lakes. Across the course of this railway there runs a precipitous escarpment, 1000 ft. or more in height as we recall, the result probably of some ancient geologic fault. The escarpment extends so far north and south and is so steep that it was found impracticable to make a detour around it or to pursue a zigzag course up its face, at least in the original construction. An inclined plane was, therefore, introduced to haul trains by cable up the escarpment; and this, so far as we are aware, is still in use.

The other plane is of more recent construction and is located in the Cuban ore fields. Its use in connection with ore traffic is much more similar to the conditions existing at Mahanoy than is the case with the African line.

It would be interesting to inquire whether there are other places in the United States where under present-day conditions a broader view in the original construction or even at the present day might lead to the use of an inclined plane instead of the locomotive as a regular system of operation. From the point of view of the operating department the advantages of the locomotive system are obvious, but there are numerous offsetting disadvantages which are perhaps not fully realized.

Taking the Mahanoy Plane for example, it will be noted that the weight of the descending train is utilized to help haul up the trains which are pulled up the plane. If the same elevation were to be surmounted by locomotives running over a long developed line, the entire weight of the train would have to be lifted to the summit, and in addition to that, the weight of the heavy locomotives required to pull the train up the hill.

Such steep-grade locomotive work is often very wasteful of fuel, as one can realize who watches a heavy freight train being slowly hauled up a steep grade with the locomotives working at a long cutoff, discharging high-pressure steam out of the smokestack and sending a large part of the fuel cast into the firebox out of the stack unconsumed. In running down such a long steep grade, moreover, there is a very large wear and tear on the car wheels and brake shoes, and accidents due to runaways on such grades are by no means infrequent.

Of course, it may be said that the handling of trains on steep planes by cables involves elements of risk; but the history of the Mahanoy Plane operation through a long period of years has shown that with proper supervision and management the accident ratio can be reduced to almost an insignificant amount.

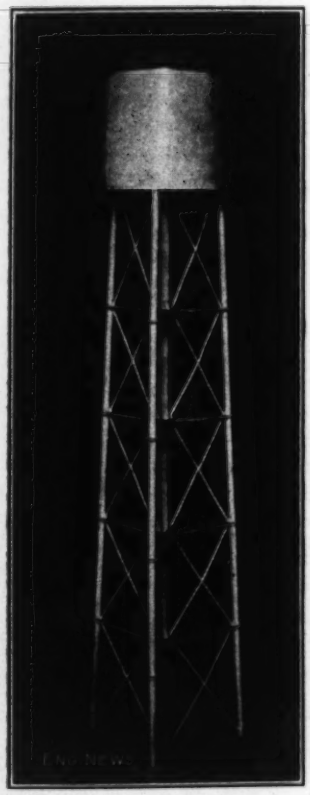
LETTERS TO THE EDITOR

Use of Models in Engineering Design

Sir—I believe I am right in asserting that it is the general opinion of engineers and laymen alike that if a perfect model to scale be made of any piece of machinery or structure and, if this model indicates proper stability, etc., this result in the case of the model would be proof of proper stability in the structure represented by the model.

Depending on circumstances or premises, this may in many cases be the proper conclusion; but it may be interesting to your readers to note some exceptions that have recently come to my notice. These exceptions have given me warning always to be careful in drawing conclusions from the use of models.

Take as a concrete example a model of a reinforced-concrete water tank and tower, illustrating a 50,000-gal. structure on a tower 83 ft. high. The model shown in the halftone is made of wood and pasteboard and represents a concrete structure as proposed to be built. The model is to a scale of 1:30; i.e., the tank part in the model is about 8½ in. in diameter and 8 in. high to represent a tank 22 ft. in diameter (21 ft. inside diameter) and 20 ft. high. The columns in the model are about ¾ in. and ½ in. in diameter to represent the 24-in. and 16-in. diameter of the proposed concrete columns for the center column and side columns respectively.



MODEL OF A 50,000-GAL. REINFORCED-CONCRETE TANK AND TOWER

If a true model of this kind had been made of concrete, with reinforcement also to scale, the tank in the model would hold only $^1/_{27000}$ of 50,000 gal. of water, or less than 2 gal. The legs of the tower, however, would each have $^1/_{900}$ part the same cross-section as the legs in the 50,000-gal. tower represented by the model and would be capable of holding up $^1/_{900}$ part as much load as this 50,000-gal. tank and tower, or some 56 gal. of water instead of the not quite 2 gal. contained by the model. This would also apply to the foundations resting in the earth.

Moreover, in the case of the actual 50,000-gal. structure, the weight of the structure itself above foundations is about 270,000 lb., whereas the weight of the model would be only $^1/_{27000}$ as much, or about 10 lb., and so the load on the columns from the weight of the tank and tower would, in case of the model, give only $^1/_{30}$ as much unit compression stress in the columns and only $^1/_{30}$ as much unit load on the foundations as in the case of the tank and tower itself.

In other words, it appears that in the case of such a structure as this, where the important feature of the design is the stress per unit area in the cross-section of the members, but where the cubical contents of the members themselves or of volume contained enters into the matter, the model is stronger than the structure illustrated, in the exact inverse ratio of the scale of the model.

In this connection, also, let us look into the hoop tension in the wall of the tank itself as compared with what it would be in the model. The tank is 30 times as deep and has 30 times as great diameter as the model and hence the hoop tension would be 30 multiplied by 30, or 900 times as great per unit of height as in the case of the model. In the case in hand the hoop tension at the bottom per vertical inch for the tank (21 ft. inside diameter) is

$$\frac{20 \times 62\frac{1}{2} \times 10\frac{1}{2}}{12} = 1090 \text{ lb.}$$

and for the model (per vertical inch of the model) would be

$$\frac{20 \div 30 \times 62\frac{1}{2} \times 10\frac{1}{2} \div 30}{12} = 1.21 \text{ lb.}$$

We must remember, however, that one vertical inch of the model corresponds to 30 vertical inches of the tank itself, and in these 30 vertical inches the hoop tension would be about 30 × 1090, or 32,700 lb., which is the figure to use in comparison with the 1.21 lb. hoop tension in the lowest vertical inch of the model. Here, as to load, we again find we have the ratio

$$\frac{1}{30 \times 30 \times 30} \text{ or } \frac{1}{27{,}000}\left(\frac{1.21}{32{,}700}\right)$$

But if we made the model to scale, as assumed, there would be $^1/_{900}$ as much cross-section of concrete in the wall and also $^1/_{900}$ as much cross-section of steel reinforcement in this loewst vertical inch of the model as there would be in the lowest 30 vertical inches of the tank itself.

It appears that in the case of a tank or any structure where the weight of a liquid enters into the case to make hoop tension in the sides, the model is stronger than the structure illustrated in the exact inverse ratio of the scale of the model.

In the case of the floor of the tank, depending as it does on the strength of a slab of reinforced concrete, the span, depth and width of a corresponding unit are diminished in the exact ratio of the model; the load per corresponding square unit area is diminished as the cube

of the ratio of the model ($^1/_{27000}$ in the case in hand); the reinforcement is diminished in a corresponding element to $^1/_{900}$ of the cross-section. We will find that the relative strength of the model is greater than the strength of the structure illustrated by the model in the inverse ratio of the scale of the model.

A complete comparison must take account also of the wind stresses. To gage the effect of wind on a proposed structure, it is apparent that for the same wind pressure per vertical square unit the tank and tower itself would be exactly as stable as the model, because the area exposed to the wind diminishes as the square of the scale of the model, and the area of the cross-section of the columns also diminish as the square of this scale. The relative height and width are the same in the model as in the structure; it therefore follows that the unit stresses in the members of the model tower are the same for any pressure of wind as are the members of the tower itself.

People often wonder why with muscular development not much, if any, greater in proportion than in a man, a frog can jump so much farther, in proportion. Suppose we consider it possible for a Tom Thumb to have being, let us say to a scale of 1:10 of a normal 200-lb. man, about 7 in. in height, his thigh less than 3 in. around; his weight ($^1/_{1000}$ of 200 lb.) only $\frac{1}{5}$ lb. Can anyone doubt but that such a manikin could carry a load on his shoulders of 5 lb. as easily as the 200-lb. man carries 500 lb.? The muscles of his legs have $^1/_{100}$ the cross-sectional area of those of the 200-lb. man and are $^1/_{100}$ as strong but with only $\frac{1}{10}$ the range of motion. But in considering the ability of this manikin to jump in proportion to the ability of the 200-lb. man to do the same thing we must remember that the muscles coming into play have to move only $^1/_{1000}$ as much weight (the weight of the manikin).

A 200-lb. man consumes 1000 units which we might call lineal foot-pounds of energy in propelling himself 5 ft. (his maximum jump). The manikin, having $^1/_{100}$ the muscular strength of the other, but with only $\frac{1}{10}$ the range of movement (a net strength of $^1/_{1000}$ that of the 200-lb. man) would be expected to develop one such lineal foot-pound in his maximum jump. He would therefore have to jump 5 ft. in order to consume $\frac{1}{5}$ lb. $\times$ 5 ft. $=$ 1 such unit of energy.

Does this not explain why it is that a frog, a cricket, or a flea can (from a standing start) each jump nearly, if not quite, as far as a man?

I do not know that there is anything new in the ideas suggested above as to relative strength of a diminutive model to the article represented by the model, but I am satisfied that there have been many cases where engineers or others have allowed themselves to be fooled by experiments on such models—not being able to represent the exact comparative conditions by experiment with the model. Let it be remembered that the model will be proportionately as many times stronger than the original as the inverse ratio of the scale of the model.

Wm. M. Torrance.

123 William St., New York City, Nov. 4, 1913.

Strength Deficiency of Overwet and of Undermixed Concrete

Sir—In this section of the country concrete mixed in the proportion of 1 part cement, 2 parts sand and 4 parts stone may be reasonably expected at the end of 30 days to exhibit an ultimate compressive strength ranging from 1800 to 2100 lb. per sq.in. The writer has had a number of tests made which prove this, provided the concrete is of a pasty texture, such as all authorities believe best for reinforced-concrete work.

On a building lately erected in Chicago this mix was specified and the writer saw all the concrete for one floor proportioned, mixed and delivered to the floor by the present popular chuting system. When the floor was poured, within a few minutes after the concrete was spread, cylinders were filled with concrete taken from the floor and at the age of 60 days they were tested. Six cylinders in all were filled and the strongest concrete exhibited an ultimate compressive strength of 1650 lb. per sq.in. The weakest specimen showed only 1230 lb. The average of the six was 1491 lb. per sq.in.

In the Oct. 17, 1912, issue of Engineering News there was printed a letter from the writer commenting on the use of chutes and spouts, expressing a fear that unsound concrete is liable to result. The above tests are illuminating. There is such a thing as getting concrete too wet.

The editorial on rapid concrete mixing (Engineering News, Dec. 6, 1913, p. 1139) goes to the heart of a matter too often left to the concrete-mixer salesman. There are batch mixers and mixers of the constant-delivery type. The latter the writer has never used but he can say about batch mixers that of the several types on the market there is a marked difference in the quality of batches mixed only half-a-minute. Batches mixed a full minute show less variation and all batch mixers seem to deliver concrete of approximately equal strength when the mixing is continued for two minutes. The writer found that the long mixed batch requires less water than the quickly mixed batch and it is of a different consistency, pasty rather than soupy.

The time has come definitely when the method for writing specifications must be changed. Too much copying has been done. The proportions are of less moment than the mix. Each day the writer is connected with concrete work he is more certain that, within reasonable limits, good concrete depends more upon thorough mixing than upon proportioning. The specifications should contain the following clause:

The contractor shall pour control beams of the following size ..... by ..... by ..... feet long, reinforced with ..... as per design given by the designing engineer, on each floor. These control beams shall be made of concrete taken from the floor within 15 min. after same is deposited and placed in the forms. The beams shall be stored on the floor where poured and there shall be four for each panel. One beam shall be tested at the end of seven days before removing forms and upon the strength as determined by such test the time of removing forms shall be approximated. At the end of said time a second beam shall be tested, and at the end of 30 days the last beam shall be tested. If the 30-day test shows the concrete has not reached a maximum compressive stress of 2000 lb. per sq.in. in bending, the engineer-in-charge may require the work to be torn out and replaced, or the contractor may make such reduction in price to the owner for the reduced strength, as they two shall mutually agree upon.

The foregoing seems rather drastic but it can be enforced if the city building departments decline to grant certificates of permissible floor loadings other than upon the data obtained by testing control beams or cylinders on all work, four to each panel and stored on the floor so they should be approximately equal in all respects to the concrete in the floors. The owner has an engineer

design a reinforced-concrete structure, or perhaps has his plans given to him by a steel salesman. These plans are based on a certain maximum fiber stress in the concrete, it being generally assumed that one-third the ultimate strength is a safe fiber stress. The contract is let to the lowest bidder, who proceeds to use an inferior stone, mixes half-minute or three-quarter-minute batches and sends the material down a spout or chute with plenty of "lubricating water." The resultant concrete, as the writer knows from hundreds of tests, rarely reaches three-fourths the assumed maximum strength on which the design was based. The writer believes the strength of the concrete should be put up to the contractor, precisely as we now put the quality of the steel up to the mill and the quality of the cement up to the cement manufacturer. Why should we spend good money in testing cement, which is a standard product; steel, which is a standard product; water, which does not often make trouble, and neglect completely the quality of the sand, the aggregate and the completed product, the concrete? All that is now required of the contractor is that he finish his work on time in fair conformity with the specifications for fabrication of a structure. His fabrication of the greater part of the material in that structure is given no attention.

Rapid mixing and too much water are the principal reasons, in the writer's opinion, for the disintegration of so many structures, the number of which is now attracting alarmed attention all over the country. The failure during construction is bad enough, for loss of life usually accompanies such failures, but the failure due to unsoundness, or overstressing of badly made concrete does not receive the attention from technical publications it should receive, although it is a matter of tremendous interest to the men who paid for the structures.

ERNEST MCCULLOUGH.

Monadnock Block, Chicago, Ill., Dec. 6, 1913.

The "Economical Concrete Design"; a Defense and an Explanation

Sir—I am glad to see that the little example in "economy" in reinforced-concrete design, sent you by the writer ("Subscriber") and published in your issue of Oct. 30, 1913, p. 886, has brought out some vigorous response. It was designed to do just this. As explained to the editor, this design was not intended to be serious, and, as stated, I would not stand within a radius equal to the length of any member when the forms were removed. The responses referred to are those by Messrs. A. R. James, Donald N. Becker, J. R. Worcester, and Sanford E. Thompson, published in your issue of Nov. 20, 1913, p. 1042.

If I had criticized the Joint Committee Report and condemned it over my signature, as I did some years ago, it would probably have been passed over without comment by the men who stand up for this sort of thing. But when apparently a raw recruit comes in with an abortion of a design, that anyone with any engineering instinct can see at a glance is dangerous, and when that design is based on the Joint Committee Report, attempt is at once made to whip the said raw recruit into line by showing him where he should not follow the Report literally but should interpret it in such way as not to shame the framers of the Report.

I realize that when one is continually hammering at the errors of a smug and self-satisfied profession, he is apt to get little or no response at the hands of the leaders of that profession. It will, therefore, be clearly understood why this ruse was adopted. The ruse has worked well.

I am glad to see that Mr. Thompson has pronounced my design as "absolutely absurd and dangerous." It is all of this, just as it was intended to be. I am glad too that I inadvertently failed to provide quite enough shear area in the concrete of the beam to satisfy the Joint Committee Report. I now propose to amend the design by adding one inch to the depth of the beam and one inch to the width. The shear area will then be all right and the tension on the steel, which bothered some critics, will also be right. If someone is still squeamish, I will run one of the bottom rods to the center of the post. The bearing of these rods—one inch over the supports—was not objected to by anyone, but my critics say that there is eccentric loading in the lower column. I shall explain later how this will overcome the objection. If some are not yet satisfied, I will add an "extra" in the way of two inches additional length on the ends of the stirrups, bending this over the upper beam rods to "anchor" the stirrup. Experience in inducing contractors to come within the specifications, and observation of their methods of trying to do it, come in very handy in an occasion such as this.

The objection of Mr. Thompson that my structure is not braced normal to the plane of the drawing is of no importance. It is presumed that at the girder level there are braces or beams that will hold this one laterally.

Now by the expenditure of a trifling amount in steel and concrete I have overcome all of the objections. My design is still absolutely absurd and dangerous and abominable besides—worse than it was before, because it is heavier. And, as I will show in detail later, it satisfies the Joint Committee Report to the letter. Here is something for the 30 members of that committee to ponder. They have progagated a document by which reinforced-concrete experts swear, solely, as one of them conveyed to me, because it is the pronouncement of leaders in the field.

In a meeting in Pittsburgh to which engineers were invited to discuss the proposed building code, they voted almost as one man (two dissenting votes) to adopt the Joint Committee Report as the building code of Pittsburgh. I doubt if half a dozen of them had read it (the latest revision which was the one referred to). I doubt if three of them knew that absolutely plain concrete columns twelve times as long as their diameter were allowed in that code, and that at stresses around 500 lb. per sq.in. In fact, I doubt if some of the members of the Committee know just what they have signed.

Now as to the objections in my design:

Mr. James intimates that my stirrup would better be replaced by several stirrups of smaller diameter. The Report demands nothing of the kind. It does not give any limiting size of stirrups.

Mr. Thompson says that my stirrups should be anchored. The Joint Committee Report does say that anchorage or bond should be provided, and in the next paragraph it says that web reinforcement must be looped over, or wrapped around, or be connected with the longitudinal bars that are in tension. This, I take it, is

the Committee's explanation of proper anchorage for stirrups. The floating ends of the stirrups do not seem to bother them. My stirrup passes under the tension rods. This satisfies the Report. In the amended design it also loops over the compression rods, which is not called for in the Report.

Mr. Worcester, a member of the Committee, says that the Report does not allow plain concrete columns except up to six diameters in length. I quote from the Report as published in Proc. Am. Soc. C. E., Vol. 39, No. 2, p. 156.

> For concentric compression on a plain concrete column or pier, the length of which does not exceed 12 diameters, 22.5% of the compressive strength may be allowed.

How does Mr. Worcester interpret this?

Mr. Becker says that my "hoops" are inadequate. This is not a hooped column. Someone did try to write into the Pittsburgh Building Code the latest illusion about "rectangular" hoops, but I think it will be eliminated. That would be the last word in squaring the circle. The Report says, "Bars composing longitudinal reinforcement shall be straight, and shall have sufficient lateral support to be securely held in place until the concrete has set." (This is concerning columns.) The wires used in my column are only to hold the rods in place. Wire such as used for baling hay is all that I contemplated. This is light and cheap and would completely fill the requirements of the Report. It would make the columns like the wrecks of history. I might have made the column oblong with oblong "hoops," with six vertical rods. to illustrate how a wire parallel with the face of a column holds a slender rod, also parallel with that face, from bulging out of the concrete, as standard designs have it.

Mr. Becker would skin my column. He says that only the area within the hooping is effective. I have no hooping. I know that the Report states that 1½ in. of the column should be considered as merely protective covering, and I believe that this skin saves many a structure. But what is to hinder me from protecting my structure with tile or brick? Or why can it not be located where there is no fire hazard?

Mr. Thompson says that bending stresses in the lower column are not provided for. I reply that there is rightly no bending stress to be provided for. The part above the bottom line of the girder is the girder. If there is any bending, it is in the girder, which is able to take care of it. The column is centrally loaded, just as much so as any girder resting on a bearing plate on a wall. I extended one rod to take what little tension there would be for this bending in the girder, in my amended design.

My critics have intimated that I did not adhere to the "best possible design" as though there were something that transcends the Joint Committee Report. I have been imagining myself as a notary at the shrine of the Joint Committee. Can there be anything more authoritative than their manifesto?

I suppose the old saw will be pulled on me about interpreting a set of rules upon the "broad grounds of professional intelligence and common sense." I should like to turn that saw inside out and make it read that the best set of rules is one that is fool proof and leaves practically nothing to so called professional intelligence and the uncommon thing called common sense.

Mr. Becker in his last paragraph speaks of what would happen if my beam deflects—the lower column would probably break. There isn't any doubt about it, but has Mr. Becker been reading the writings of some destructive critic? Where in all the standard literature of this subject will he find any reference, in a monolithic building, to the danger of brittle columns breaking through lack of articulation. The standard rodded column is brittle, like any plain concrete column. Its utter lack of toughness has caused an immense amount of wreckage and great loss of life. I would just as soon build the columns of a high building of granite as to make them of shafts of plain concrete with slender rods embedded in them and lacking close-spaced hoops.

The sooner the Joint Committee, and all others who are responsible for building regulations, bar forever the rodded column the better for their conscience and the safety of human beings endangered by them.

The plain concrete column—twelve diameters long—is awful. How this ever got by 30 intelligent men is a deep mystery. The Committee ought to be called in special session to eradicate and revoke this abominable rule.

My critics did not touch nearly all of the serious objections to this design. The idea of two layers of heavy rods—10 sq.in. of steel being gripped by but little more than this amount of concrete. This is preposterous and absolutely impossible, yet it satisfies the Joint Committee Report.

No one has ever shown how stirrups can take the end shear of a beam. These certainly would not. It is doubtful if they would have any appreciable stress. They might receive a sudden jerk, if the plain of cleavage should cross the stirrup, when the failure occurs. The break might occur to one side of the stirrup and leave it totally undisturbed.

The great amount of compression steel in this beam is another serious fault and the lack of anything to bind it effectually into the beam is another. In fact, slender rods in compression are a serious error anywhere. Imagine a column packed full of rods as the top of this beam is packed.

If this is productive of no further good, I trust it will at least induce the signers of the Joint Committee Report to read that report.

"SUBSCRIBER."
EDWARD GODFREY.

Monongahela Bank Bldg., Pittsburgh, Penn.,
Nov. 29, 1913.

What is a Leveler and Why?

Sir—We are much gratified with your editorial of Dec. 4, "What is a Leveler and Why?", notwithstanding that it seems to fall in with the rather general but unreasonable opinion that unloads upon the Civil Service Commission responsibility for all the shortcomings of the personnel and machinery of the civil-service system. I think that it is generally true, certainly so in New York State, that titles and grades of positions are determined by the appointing power, which is likely to view suggestions on these matters as unauthorized meddling with its affairs.

With regard to the position of leveler—whose title and salary, still on a $4.50 to $5 *per diem* basis, antedates civil-service examinations—appointments from the eligible list are made under the title of junior engineer by the Public Service Commission for the First District,

where most vacancies are now found, with duties as indicated by the questioning. The only remaining *raison d'etre* of the title seems to be that the State Engineer's and Highway departments are not furnished with field instruments and the person appointed to field work may be required to furnish, if a leveler, a level, and if an assistant engineer, a transit, which he may personally seldom or never use.

Your comment may help to persuade some of the conservative brethren in the State departments that certain of their engineering titles and grades should be renovated—something which we have lately endeavored to do. Perhaps you do not appreciate the respect in which familiar practice is held in public departments, particularly among old civil service men.

P. H. PARTHESIUS.

Assistant Chief Examiner, Civil Service Commission, State of New York.
Albany, N. Y., Dec. 9, 1913.

Sir—Referring to your editorial, "What is a Leveler and Why?" Dec. 4, 1913, p. 1141, I quote as below from the "Instructions for Preliminary Work, Department of the State Engineer, State of New York:

TRANSIT WORK—A transit party will, under general conditions, consist of one assistant engineer, one leveler, one rodman, two chainmen, one to two laborers, and one team (when required). The assistant engineer will have direct charge of the party.

LEVEL WORK—1. A level party will consist, under ordinary conditions, of the same force as the transit party, the same party to perform both transit and level work.

STADIA WORK—1. A stadia party under general conditions, will consist of one assistant engineer, one leveler, one rodman, two or three chainmen and one or two laborers. The assistant engineer will be in charge of the party and the details of the organization; as to who shall act as the observer at the instrument, and who shall do the sketching will be left to his judgment, subject in all cases to the approval of the Resident Engineer.

SOUNDINGS—A sounding party will, under general conditions, consist of the same organization as the stadia party, boats being used when required.

BORINGS—1. A boring party will consist of one foreman, three or four laborers, and one team to transport one or more boring parties, and to haul the water used in boring.

7. Boring parties will be under the control of such assistant engineer or other employee as the resident engineer in charge of the section may designate, but the laborers composing the party will be under the immediate control of the foreman in charge.

Comparing these organizations with those of a usual railroad survey, we note marked differences. What is the practical working of the system as laid down in the "Iustructions"? Suppose the transit party is running the center line for the Barge Canal. The Assistant Engineer, of course, is in charge of the same. On whom does the work of running the transit devolve?

Before proceeding further it may be well to state here that assistant engineers are required to furnish one transit in good condition, with vertical arc and level on the telescope and with fixed stadia wires arranged to read about one foot at a distance of 100 ft. Levelers are required to furnish one Y-level in good condition and suitable to the work required. Rodmen are required to furnish a 12-ft. extension leveling rod with target and vernier.

Suppose the assistant engineer directs that the leveler or the rodman shall run the transit. Of course they do not have to furnish a transit and so must use that belonging to the assistant engineer. This arbitrary assignment of positions happens frequently. There are cases where a rodman, and even a laborer, acts as transit-man and the leveler as chainman. Suppose a mishap occurs to the transit, the man running the instrument falls down; the transit has to be repaired at the expense of the assistant engineer who owns it, and work is held up until the repairs are made. No other instrument is available, as the state owns none.

This regulation dates from about the year 1835, when the Canal Commissioners of that date in solemn conclave assembled, decreed *"that the engineers must furnish their own tools,"* which may be interpreted more ways than one.

Suppose the party is doing level work. Theoretically the leveler should run the level, that is what he is paid for, and does he not own the level? Oftentimes this duty is delegated to the rodman, and his place is taken by the chainman or even by a laborer, neither of whom own level rods.

By some oversight (which can hardly be condoned) chainmen do not have to supply chains, as steel tapes is the universal practice.

When it comes to office work, we find levelers and rodmen acting as draftsmen. Why? Because they are naturally proficient in this line of work. Oftentimes a rodman is an expert letterer and so does this special class of work. The same thing applies to construction work. Apparently men best qualified for particular kinds of work are placed in charge regardless of title. Then What is a Leveler, and Why?

LEVELER.

Albany, N. Y., Dec. 6, 1913.

The Water-Supply of Glasgow, Scotland, is being increased and further extensions are contemplated. The city has been supplied from Loch Katrine, the available supply from which is now 67,000,000 Imp. gal. per day. To increase this amount, a dam across the Arklet Valley has been built and a tunnel about a half mile long has been completed connecting Loch Arklet with Loch Katrine. The improvements take in an additional drainage area and give extra storage sufficient to supplement the Loch Katrine supply by an average of 12,000,000 Imp. gal. per day. Plans have been prepared by John R. Sutherland, engineer of the Glasgow Water Department, for further increasing the supply by raising the common level of Loch Voile and Loch Doine 45 ft., by the construction of a dam at the east end of Loch Voile. The two lochs are connected by a narrow valley. A tunnel about six miles in length will be driven from Loch Doine to Loch Katrine, ending on the north shore of the latter about 25 ft. above the top water level of that loch, whence the water, after being measured in a gage basin will run down a natural watercourse into Loch Katrine. It is estimated that Loch Voile and Loch Doine together will give an additional supply of fully 50,000,000 Imp. gal. per day to Glasgow, or a total of, say, 135,000,000 Imp. gal. from all four lakes.

The Glasgow water-works supply, besides Glasgow, about thirty towns and villages with a population of some 1,130,000, all told. The average daily consumption for the year ending May 31, 1912, was 70,703,000 Imp. gal. This was at the rate of 62.5 Imp. gal. per capita, divided into domestic 40.5, and trade 22 Imp. gal. Domestic water consumers, as tenants of houses, pay very low rates for water, the charges being assessed "on full annual value" (rental value of premises served) at the rate of "4d. in the £ within and 10d. in the £ beyond the municipal boundary" (about 1.65% and 4.15% respectively). For the year of 1913-14 the domestic rate within the municipal boundary has been raised from 4d. to 6d. per pound of rental (or 2½%). In addition to this, all property within the city of Glasgow pays 1d. in the pound as a public water rate, which is really a general tax in aid of the water department, payable not by tenants but by owners of property. Water for trade purposes is supplied to "warehouses, etc., according to appliances," and factories are supplied through meters at 3¾d. per 1000 Imp. gal., or about 6¼ per 1000 U. S. gal. We are indebted to Mr. Sutherland for information given in this note.

The Failure of the Stark-Lyman Building, Cedar Rapids, Iowa

Except for a characteristically unsatisfactory coroner's inquest the failure of the Stark-Lyman reinforced-concrete building at Cedar Rapids, Iowa, noted in ENGINEERING NEWS, Nov. 27, 1913, p. 1104, has not been made the subject of any official investigation. The facts available in the matter of the failure are very little more than were published in our previous account. The inquest noted above was held by a coroner of the usual type before a jury of no particular qualifications. A certain number of eye witnesses of the accident appeared and a few competent technical men testified as to information available, but no considered attempt was made to analyze the design of the building and but very little attention was paid to the construction. As a result of the investigation the jury gave the verdict that the failure of the building was "due to faulty and insufficient falsework used in supporting the concrete construction" of the rear two sections of the building. We have been informed that this closes the case for the county and the city, and any further official investigation will have to be as a result of damage suits which possibly may be brought.

We have endeavored to secure the plans of the building from the engineer for the owner, but have been informed that they are in attorney's hands and are not available. We cannot, therefore, give to our readers any further description of the design than appeared in our previous article. The measurements there given are the ones taken on the work a short time after the accident. It may be well, however, to note the following information, forwarded to us by Prof. E. J. Lambert, of the University of Iowa, in regard to the design of the building. In connection with the figures given by Prof. Lambert, we give also the specifications for the design as forwarded by the owners to the consulting engineer.

STRESSES IN BUILDING

It will be remembered that the building was 60x140 ft. in plan, comprising three transverse and seven longitudinal 20x20-ft. bays. The floor slab was made up of 7x12-in. hollow tile spaced 4 in. apart so as to permit of intermediate concrete beams, reinforced with two ½-in. rods, which with the 2-in. concrete flooring, makes a T-beam with 4x7-in. web and 2x16-in. flange. This slab is supported by transversely disposed 12x25-in. girders spanning the 20 ft. between columns. These girders are reinforced with about 0.8% of steel. The plans call for 12x12-in. columns in the upper story with an increase of 2 in. each way per floor. As built, however, the columns were round and reinforced with spiral hooping.

The prescribed specifications for the design were as follows:

Live load (second to seventh floor)	95 lb. per sq.ft.
Tension in steel	20,000 lb. per sq.in.
Bending compression, concrete	750 lb. per sq.in.
Direct column stress, concrete	600 lb. per sq.in.
Ratio of moduli of elasticity	12

Bonding moment WL ÷ 12 in center of span and WL ÷ 10 over supports.
All span lengths to be clear spans.

In comparison, the following notes by Prof. Lambert are given:

I have taken measurements of the floor-beams and columns both in the failed and standing structure and submit some computations based on these measurements, and the loads as specified. For purposes of comparison I quote from the Joint Committee on Concrete and Reinforced Concrete such specifications and recommendations as are applicable to this case.

(1) The span length for beams and slabs shall be taken as the distance center to center of supports.

(2) Ratio of moduli of elasticity = 15.

(3) For beams, bending moment for end spans shall be taken at WL ÷ 10 for both dead and live load.

(4) Extreme fiber stress of a beam 650 lb. for a 2000 lb. concrete.

(5) Extreme fiber stress for steel not to exceed 16,000 lb.

(6) Column reinforced with longitudinal bars and hoops, about 650 lb. for 2000 lb. concrete.

FLOOR BEAMS

In the Stark-Lyman Building the panels are approximately 20 ft. square. Since the floor slab is continuous over seven panels, and not fixed at the ends, the reactions at the first floor-beam from the end are about 15% in excess of what would be produced by simple slabs of 20-ft. span. An examination of the 8-in. wall into which the floor slab reinforcement extended seemed to show that one of each pair of ½-in. rods was bent up to the top of the slab and extended 4 to 6 in. in the wall, the adhesion of the concrete to this rod being the only anchorage. This end could, therefore, be assumed as simply supported without any resisting moment except that due to the friction on a few inches of ½-in. rod.

The dead load per sq.ft. of floor is about 75 lb.; the live load is specified as 95 lb. The floor-beam 12x25 in. weighs about 200 lb. per lin.ft. (exclusive of the top 9 in.) The load per lineal foot of floor-beam is, therefore, approximately 200 lb. + (75 + 95) 20 × 1.15 = 4110 lb., of which 1925 lb. is dead load and 2185 lb. live load.

$$\text{The bending moment} = \frac{WL}{10} = \frac{4110 \times 20 \times 20 \times 12}{10} = 1{,}970{,}000 \text{ in.-lb.}$$

As nearly as could be determined in a failed floor-beam, the reinforcement was 0.8 of 1%. With these conditions the unit stress in the concrete would be 1680 lb. per sq.in., and in the steel 41,000 lb. per sq.in. Under dead load only the stresses in concrete and steel would be 785 and 19,200 lb. per sq.in., respectively. The loading on the floor-beam is eccentric by about ½ in. from center line, thus causing even greater stresses than above computed.

COLUMNS

Upon measuring the second floor interior columns they were found to be 20 in. in gross diameter, excepting two columns of 24 in., on which a roof tank was to be supported. The reinforcement consisted of eight 1-in. twisted bars and ⅜-in. spiral hooping.

In a continuous beam of three panels, end free, the reaction at the second support is 12½% larger than for simple beams. At the ends of floor-beams no anchorage of reinforcing rods seemed to have been used. The single floor load going to a column would be (75 + 95) (1.12½ × 20) (1.15 × 20). The total load coming to the second floor column would be the roof load, plus five floor loads, plus five columns, plus six floor-beams, as follows:

Dead load:

Six floor-beams, 200 lb. per lin.ft. × 22½	26,000
Five columns, average 20 in. diam. by 12 ft. long	20,000
Roof, 22½ × 23 × 65 lb.	33,600
Five floors 22½ × 23 × 75 lb.	194,000
Dead load	273,600
For full live load of 95 lb. on each floor and 65 lb. on roof, the live load on second floor column would be: 5 (95) + 65 × 22.5 × 23 =	279,000
Total	552,600

The effective size of column = 20 in. — 2 (1½) = 17 in. inside diameter of hoop, or an area of 227 sq.in., with 8 sq.in. longitudinal reinforcement.

As has been previously stated, the building is to be used as a wholesale millinery establishment; therefore, the assumption of a possible full live load on each floor is not unwarranted.

Under dead load only, which is practically the same as the live load, the stresses seem to figure abnormally high, while under full live load the concrete would be stressed practically to its ultimate capacity over 1000 lb. per sq.in. If a panel 20x20 ft. only is considered the load on the second floor column is as follows:

	Pounds
Dead load	220,000
Full live load	216,000
Total load	416,000

or about 1300 lb. per sq.in. on concrete. For dead load only the unit stress in the concrete is higher than recommended by the Joint Committee for the total allowed stress under both dead load and live load.

The figures show so pronounced a difference from those of the design that some defense would seem to be obligatory on the designers even though it is granted that under good conditions of building the stresses shown by Prof. Lambert's figures would not have been sufficient to cause failure.

On the evidence which is now at hand it seems certain that the initial failure was in the fifth floor of the building, which was unsupported by centers and which although only about a month old was carrying the weight of the sixth and seventh floors and the partially finished roof.

A committee appointed by the City Council has investigated the standing parts of the building and has reported that with the exception of a few members near the failed section, the building is safe.

Annual Meeting of the Society of Naval Architects and Marine Engineers

The 21st general meeting of the Society held in New York City on Dec. 11 and 12 had a registered attendance of about 500. Due to the unfortunate illness of the president (Colonel Robert M. Thompson), Vice-President W. M. McFarland presided.

The address of Mr. McFarland sketched briefly engineering progress, as related to the interests of the Society, during the past year. In commenting upon the use of fuel oil for the propulsion of ships, an interesting rule was given: Oil is economical when its cost in cents per gallon is not greater than one-half the cost of coal in dollars per ton; i.e., oil at two cents per gallon is more economical than coal at four dollars per ton.

The first two papers of general interest dealt with the possibility of building unsinkable vessels, and the changes in their structure to accomplish this. Wm. Gatewood, whose paper treated the latter feature, expressed the opinion that

> subdivision by transverse bulkheads, combined with suitable freeboard, is the logical method of preserving buoyancy and stability; that the proportion of the length of the vessel which may be damaged without danger of foundering should regulate the spacing and height of the bulkheads; and that for a coastwise steamer of standard type, carrying passengers small in number compared with the Atlantic liners, no other subdivision would seem necessary.

H. A. Everett, Assistant Professor of Marine Engineering, at the Massachusetts Institute of Technology, offered a paper on the "Stability of Lifeboats," which represented the results of inclining experiments and subsequent stability calculations upon four types of 28-ft. lifeboats: first, standard metallic; second, standard wooden; third, metallic; and fourth, collapsible wooden. The tests on the collapsible boat were not reassuring to those who believe in this type as, even in an unloaded condition, water leaked into the pontoons or chambers between the decks. Of course, in any wooden boat, subject to the weather and wear of service, leakage is bound to occur; but when such leakage occurs in a space where bailing is impossible, the stability and buoyancy are seriously impaired.

"Change of Shape of Recent Colliers," by Naval Constructor S. F. Smith, U. S. N., gave the results of hogging and sagging on some of the 500-ft. colliers recently built for the U. S. Navy. In the discussion, it was stated that this trouble was frequently encountered on the Great Lakes in the loading of ore steamers. A specific instance was given where the draft was the same at the stern and amidships, but one foot greater at the bow.

"Notes on Chain Cables," by J. E. Otterson, brought out an interesting discussion. The author stated that the best chains were made by hand but that with the increasing size of vessels the time was fast approaching when it would be impracticable to rely altogether on this method. It is interesting to note in this connection that the largest chain in the United States of which there is any record was made 130 years ago for the purpose of preventing the British ships from ascending the upper Hudson River. It was made at Stirling, N. Y., and was 1500 ft. in length. The links, which weighed 275 lb. each, were made of 3½-in. square iron. The chain cost $2000 per ton.

James E. Howard, Engineer Physicist, Bureau of Standards, stated that in testing chains the proof stress should be above the working stress and sustained a sufficient period to prove the strength of the chain. He also called attention to the fact that the test overstrains the chain and that re-annealing might be advisable. This process would soften and toughen the iron, rendering it less liable to break.

Mr. Howard's paper on "Strains in Hull of Ship at Sea and Strains Measured While Receiving Cargo," elicited much interest, as the author is the leading investigator in this direction. Measurements were made on the deck plates of the steamship "Ancon," of the Panama R.R. & Steamship Co. Live-load strains on the deck plating while at sea were determined with a new type of live-load extensometer termed, from its shape, a "scissors gage." This instrument was described in ENGINEERING NEWS, Oct. 9, 1913, p. 701. Measurements were made on the solid plates and spanning their lap joints. The greatest stress was found to be in the angle iron of the rail, near the bridge, where a range of 5500 lb. per sq.in. was observed. Strains due to pitching were generally double those due to the engines; the latter were recognized by their periodicity. This paper appeared only in abstract for presentation but will be published in full in the transactions of the Society. It is an important contribution, as direct information on this subject is meager.

Mr. W. L. R. Emmet's paper on "Electric Propulsion on the U. S. S. 'Jupiter,'" described the electric equipment of that 20,000-ton displacement collier, which includes one turbo-generator and two induction motors, one driving each of the propeller shafts. This turbine is of especial interest, being the first of a type. Mr. Emmet strongly emphasized the value of the high-speed turbine, stating that it is as applicable to sea service as to the central station. An interesting point brought out was that when the propeller lifted from the water, in a rough sea, the speed indicator showed no increase in the revolutions; the decrease in load was indicated by the ammeter.

The social function of the convention was the dinner on Friday evening at the Waldorf-Astoria Hotel, at which 275 were present. The presidency of Colonel Thompson continues for 1914 and Daniel H. Cox was reëlected Secretary-Treasurer.

Annual Convention of the American Road Builders' Association

The tenth annual convention of the American Road Builders' Association and the fourth American Good Roads Congress, held in Philadelphia, Penn., Dec. 9-12, inclusive, is acknowledged to have been the largest and most successful convention the association has yet held. The registered attendance was approximately 2500 and the exhibit of road-making machinery and materials was complete and full of interest.

The papers presented were for the most part collections of general principles, seldom dealing with the specific difficulties or experiences of the writers. The discussions, unfortunately for the interest and information of the audience, were prepared in advance, so that in almost every instance after a few words of commendation of the original paper the discussion consisted of an independent treatise on the same general subject, often much longer than the original paper. This made the sessions so long drawn out that there was apparently neither time nor inclination to discuss points of interest and personal experience by delegates on the floor. Only at the last session, when probably two-thirds of the delegates had left, was there anything resembling a real discussion.

The morning session on Dec. 9, scheduled to begin at 10 a.m., really began at 1 p.m. President Samuel Hill, of Washington State, presided. Papers were presented as follows:

Highway Organization

Highway Officials and Laws—Col. E. A. Stevens, commissioner of public roads of New Jersey, had as his text, "Highway Officials; Their Duties and Powers," but his paper dealt with New Jersey good roads in general and prospective methods of finance as well as with highway officials. A. N. Johnson, state highway engineer, of Illinois, outlined the new Illinois highway law which puts all road work under County Engineers or County Superintendents, appointed by the County Commissioners from civil-service lists. Mr. Johnson believed in giving the local county officials as much authority over their own roads as was consistent with the working out of a comprehensive system of roads; he said the one weak point in the law was the authority given the county officials to fix the salary of their County Engineer, which in some counties was ridiculously low. This, he expected, would be remedied by an amendment to the law providing a minimum salary for the office. A. R. Hirst, state engineer of Wisconsin, very wisely pointed out that there could be no universal law or highway organization adaptable to every state. The organization, like the character of the roads themselves, must be made to fit existing conditions. In Wisconsin, the jurisdiction over local roads is divided among 1200 towns and cities, and while Mr. Hirst stated such conditions were far from ideal, an organization and method of work had nevertheless been developed which met every requirement.

Division of Expense, Federal Aid—S. Percy Hooker, state superintendent of highways of New Hampshire, and those who followed him in the discussion of this general topic, took it as a foregone conclusion that Federal aid is inevitable. Mr. Hooker was unqualifiedly opposed to any scheme by which the Federal funds should be doled out in cash to the different states to be used as the local authorities see fit, but believed the amount should be portioned out dependent upon several conditions to be met by the various states applying for federal aid. N. P. Lewis, chief engineer of the Board of Estimate and Apportionment of New York City, concurred with Mr. Hooker in opposing any scheme for doling out cash. He gave a short historical sketch of the policy of the federal government toward internal improvements, referring to the disastrous results which followed a former attempt of federal government to distribute a treasury surplus to the different states. Road construction, he said, should not be standardized, but the construction adapted to local materials; and if a federal-aid road should not be properly maintained the Federal aid should be withdrawn. Harold Parker, former chairman of the Massachusetts Highway Commission, held that any federal legislation at this time was wrong, and that no action should be taken until the subject had been thoroughly investigated by a federal commission to be composed of a business man, a lawyer and an engineer. J. de Pulligny, Director of the French Mission of Engineers to the United States, said that contrary to the popular impression, federal roads in France constituted only a very small percentage (not over 6%) of the public roads of that country. Over 90% of the roads belong to township systems and are maintained by their respective localities. W. A. McLean, Commissioner, Department of Public Roads, Toronto, Ont., spoke briefly of federal aid in Canada.

Relation of Contractor and Engineer—Under this text F. L. Cranford, contractor, of New York City, advocated less politics and more responsibility for engineering inspectors. The discussion of Maj. W. W. Crosby, chief engineer of the Maryland Geological and Economic Survey, and H. W. Durham, chief engineer of the Bureau of Highways of the Borough of Manhattan, New York City, emphasized the need of care in delegating authority to inspectors and of the need of making the inspector's position a stepping stone to something better, which has not been the case in the average city. Fred. E. Ellis, Manager of the Essex Trap Rock & Construction Co., Peabody, Mass., gave a contractor's view of the causes of harmony and discord between the engineer and the road contractor. C. S. Webster, Chief of the Bureau of Surveys, Philadelphia, Penn., defended blanket clauses in specifications as guards against dishonest bidders.

Convict Labor—Dr. Joseph Hyde Pratt, state geologist of North Carolina, outlined a system of organizing a convict-labor camp, dividing the convicts into three classes, to be treated according to the class in which they were, but making it possible and desirable for each convict to better his condition by good behavior. C. M. Kerr, assistant engineer, State Highway Department of Louisiana. told of the success of convict labor in that state.

Highway Construction

Alignment and Grading—S. D. Foster, chief engineer of the State Highway Department of Pennsylvania, outlined some general principles, universally accepted but often overlooked, governing the location, grading and drainage of highways. R. A. Meeker, engineer of the Department of Public Roads, New Jersey, thought that 5% should be the maximum grade on improved roads and ½% the minimum, which was required for proper drainage. J. A. Johnston, division engineer, Massachu-

setts Highway Commission, said a maximum grade of 5% could not be adhered to in that state, that the actual maximum was 6½% and on town roads often as high as 8%. He said modern road construction was so expensive that a large expenditure on drainage and foundation was justified.

ROAD SURFACING—In a paper entitled "Factors Covering a Proper Selection of Road or Street Pavement," L. R. Grabill, superintendent of suburban roads, Washington, D. C., gave a comprehensive compilation on the economics of road surfacing, based on the authority of numerous textbook writers. Col. Wm. D. Sohier, Chairman of the Massachusetts Highway Commission, advocated a traffic census in every instance and quoted European and Massachusetts experience. W. A. McLean, of Canada, R. B. Gage, chemist, Department of Public Roads, New Jersey, and D. B. Goodsell, assistant engineer, Bureau of Highways, Borough of Manhattan, New York City, presented discussions of considerable length.

DETAILS OF CONSTRUCTION—This part of the session promised to prove very helpful, for it was to be composed of a half-dozen or more short papers on various types of construction, by engineers of experience, but in almost every instance only the most widely known and generally accepted principles were taken up.

UNIT PRICE VS. LUMP SUM CONTRACTS—H. C. Hill, engineer of the Lane Construction Corporation, Meriden, Conn., advocated unit-price contracts as preferable to both the lump-sum method and the percentage method; and in this he appeared to have the support of other contractors who discussed the paper.

TESTING OF ROAD MATERIALS—Prevost Hubbard, in charge of the Division of Roads and Pavements, the Institute of Industrial Research, Washington, D. C., presented a small-sized thesis on this subject, which was considerably lengthened by the written discussions of two brother chemists, J. E. Myers, chief chemist, New York State Highway Commission, and C. S. Reeve, chemist of the U. S. Office of Public Roads. One of the engineers present was bold enough to suggest blanket specifications to stimulate competition in bidding and specific specifications to govern the use of the particular material accepted or offered, for there seems to be a wide difference of opinion on the relative merits of various materials, particularly bituminous cements and binders, and asphaltic oils. The time, however, was too limited for a further discussion of this point.

HIGHWAY MAINTENANCE

SUB-ORGANIZATION FOR MAINTENANCE—J. N. Carlisle, state highway commissioner of New York, presented a paper on this subject noteworthy for its brevity. In it he advocated a section-gang organization which has been recommended for New York in the recent report of the board of consulting engineers.* C. J. Bennett, state highway commissioner of Connecticut, did not agree with Mr. Carlisle as to standardizing a system of maintenance, but advocated that extensive repairs be made by contract. The repair and the construction departments should be under different heads, he thought; and in this he was upheld by J. S. Gillespie, road commissioner of Allegheny County, Penn.

METHODS OF RENEWALS AND REPAIRS—The paper of A. W. Dean, chief engineer of the Massachusetts Highway Commission, on this subject covered very briefly the general principles as applied in his state. The several papers written as discussions were general in character and served to demonstrate that road problems are essentially local in character, for which there are not and never can be universal solutions.

BITUMINOUS SURFACE TREATMENT—Wm. H. Connell, chief of the Bureau of Highways, Philadelphia, Penn., presented a paper which contained few of the often repeated general principles but presented briefly and systematically just what the Philadelphia practice was and what it cost, in fact the very things which other engineers did not know but want to know. Following Mr. Connell's paper was the only free-for-all discussion of the whole convention, and from the variety of the subjects discussed and the many taking part in the discussion, a listener could not help but draw the conclusion that all the sessions would have been far more interesting and instructive if some of the long written discussions had been omitted and any delegate given time and opportunity to ask questions or relate his own experience.

ENTERTAINMENT—As a social gathering the convention was an unqualified success. Thursday afternoon, Dec. 11, was spent in an automobile inspection trip covering recent road and pavement work in and around Philadelphia. Thursday evening was devoted to a public meeting in the grand ballroom of the Hotel Bellevue-Stratford, at which a number of popular addresses were made. The annual banquet of the association was held at the Bellevue-Stratford, Friday evening, Dec. 12.

BUSINESS—The convention unanimously adopted resolutions that the American Road Builders' Association should have a committee of three to confer with committees of similar good roads associations to form a scheme for united action on the question of federal aid for roads; also that the association petition congress to take no immediate action, but to appoint a committee of three to investigate ways and means of applying federal air, this commission to be given time and means to conduct a thorough inquiry abroad and to report to the President of the United States. A resolution was adopted which is intended to be a step toward uniting all of the national good-roads organizations.

*See "Engineering News," Nov. 13, 1913.

A Contract for the Largest Electric Hoist in America was recently awarded by the North Butte Mining Co. to the Westinghouse Electric & Manufacturing Co. The hoisting drum, which will be 12 ft. in diameter, will be driven by a direct-current motor of the type used in steel mills, running at a speed of about 71 r.p.m. This motor will take power from a motor-generator set equipped (see "Tests of an Electric Hoisting Plant, Ilgner Fly-Wheel Type," "Eng. News," Oct. 27, 1910, p. 464), with a 15-ton flywheel for the elimination of peaks in the power line during starting and acceleration. The electrical equipment alone will weigh more than 250 tons. The hoist motor will have a maximum intermittent rating of 4500 hp. and the motor-generator set will be driven by an induction motor having a continuous normal rating of 1400 hp. The difference between these ratings, of course, represents approximately the amount of energy that will be supplied by the flywheel during starting. Round rope 1⅝ in. in diameter will be used, and the equipment is designed for a normal rope speed of 2700 ft. per min. with a maximum of 3000 ft. per min. The capacity of the hoist will permit 300 tons per hour, being hoisted from a 2000-ft. level, or 200 tons per hr. from a 4000-ft. level. The ore will be handled by means of skips having a capacity of seven tons each. Hoisting will be accomplished in balance, but the equipment is large enough to take care of unbalanced hoisting. A number of special safety devices are included in the equipment; e.g., electrically released brakes; automatic slow-down devices to prevent the skip or cage from going through the head sheaves, and a special controller to limit the speed when men are being hoisted.

Reconstructing the Foundation of the Elwha River Dam

The foundation failure of the Olympic Power Co.'s concrete dam on the Elwha River, near Port Angeles, Wash. (Oct. 30, 1912), was of an unusual character and the restoration of the foundation presented special problems due to limitations of cost in order that the investment might still be retained on a paying basis. The construction and failure were described in our issues of Dec. 5 and 26, 1912.

The dam is a concrete structure between the rock walls of a mountain cañon, and unfortunately was placed upon a river bottom of sand and gravel. It is about 110 ft. high, and 50 ft. long on the bottom, having two core walls about 30 ft. deep extending down into the sand. The depth of the sand fill above the dam, including that above the core walls was about 60 ft. The dam had been completed and a head of 90 ft. had been carried for nine days when a blowout occurred through the sand and gravel, leaving the dam spanning the cañon like a concrete bridge or girder 100 ft. deep. Previous to the failure, flood water passing through the sluice gates had washed away a considerable amount of the sand immediately below the toe of the dam, thereby weakening the foundation. By subsequent borings it was ascertained that the rock bottom of the cañon was from 70 to 116 ft. below the bottom of the dam.

The river has a flow ranging from 1200 to 40,000 cu. ft. per sec., and the combination of a deep bed of loose material with the occurrence of heavy floods made the restoration of the dam along general lines of practice a difficult and expensive problem. With the mean low-water flow at the time the work was begun there was a depth of about 20 ft. of water, and 70 to 80 ft. of sand and gravel in the river bed below the dam.

Various methods were proposed for closing and sealing the opening under the dam, but in view of the heavy investment already made (over $1,000,000) it was of great importance that the cost should be as low as possible. It was estimated that to carry the dam down to solid rock by means of pneumatic caissons would cost some $600,000, but the method adopted and now being carried out is estimated to cost under $150,000. The principle involved in this method of restoration was first to obtain in the bottom of the river, below the dam, a toe of sufficient weight and stability to carry the requisite fill to be placed above the dam, and to resist any tendency to scour. The method is illustrated by the diagrammatic section in Fig. 1.

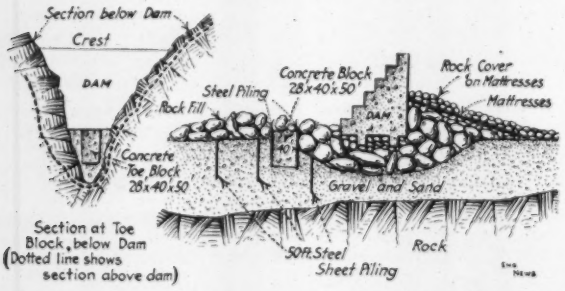


FIG. 1. DIAGRAMMATIC SECTION ILLUSTRATING THE METHOD OF PERMANENTLY CLOSING A BLOWOUT BENEATH THE DAM ON THE ELWHA RIVER, NEAR PORT ANGELES, WASH.

About 15 ft. below the toe of the masonry dam a row of interlocking steel piling 50 ft. deep, was driven across the river. This piling was carried down by using a fol-

FIG. 2. BUILDING A CRIB OF STEEL SHEET PILING IN THE CAÑON OF THE ELWHA RIVER, TO BE FILLED WITH CONCRETE TO FORM A TOE FOR THE ROCK FILL AT THE DAM

lower until the top was level with the bottom of the river; that is, with the top of the sand in the bed. This made the lower end of the piling 70 ft. below the surface of the water, or about 12 ft. above the rock bottom.

At 10 ft. below this row of piling, a box or crib of steel piling was driven in the river bed. This box is 28x40 ft., with its longer axis in the direction of the current, the width of the river at this point being about 70 ft. These piles also were 50 ft. long, and were driven till their tops were just above mean low-water. The inclosed material was then excavated with a derrick and clam-shell bucket from above and in the wet. Very little bracing sufficed to make the caisson strong enough to resist the pressure of the sand and gravel on the outside, and it was found possible to excavate somewhat below the bottom of the steel piling. Concrete was then deposited in this box (in the wet) by bottom-dump buckets; the water being still, there was no wash by current or eddies. When this concrete had set it formed a massive block or toe of some 3000 tons. Fig. 2 shows the construction of this caisson and gives a good idea of the character of the cañon.

At 10 ft. and 60 ft. below this concrete block, two other rows of steel sheet piling were driven across the river bottom, similar to the first row. Over this 135 ft. of inclosed river bottom there was blasted down from the sides of the cañon a paving or rock fill of very heavy masses,

with smaller rock filling the voids; the larger rocks ranged from 5 to 30 tons in weight. The fill thus made was about 24 ft. deep.

In preparing for this blasting work, and taking advantage of the natural construction of the cañon, it was necessary to drive gopher holes and drill holes in such a way that a large amount of the material could be thrown into the river above and immediately adjacent to the original structure. The gopher holes went back some 50 ft., with laterals 15 and 30 ft. long and pockets 5 to 8 ft. deep. Cracking and spreading lines and direction lines of cleavage were obtained by drill holes about 30 ft. deep. The rock fill, amounting to some 47,000 cu.yd. was thrown down by firing 16 tons of dynamite and powder in three blasts within about three hours. Although the lines of cleavage came as close to the original structure as 10 ft., there was practically no damage done.

In four days after the blast was fired, the elevation of the upper pool was 127 and that of the lower pool 84, the mean low-water level in the lower pool being 82. This head has been carried since Nov. 4, during which time the water over the spillways has been 14 ft. deep. The fill is being rapidly made water-tight by brush fascines and mats and other suitable material.

The interlocking steel piling was of the United States section, which was considered the easiest and most rapid to drive. It was of the 12-in. width, weighing 35 lb. per sq.ft., and in 50-ft. lengths. The piles were driven by a McKiernan-Terry steam pile hammer of the No. 9 size, delivering a blow of about 1600 lb. per sq.in.

The plan for this restoration required little equipment, and as the work was handled from above there was little preparation required. The dam itself is being altered considerably, especially in improving the spillway section as to capacity and foundation, and in introducing steel Taintor gates instead of stop-logs.

This work has been carried on by James O. Heyworth, engineer and contractor, Chicago, Ill., under the supervision of D. W. Mead and C. V. Seastone, consulting engineers, Madison, Wis.

NOTES

The Colorado St. Bridge across the Arroyo Seco in Pasadena, Calif., described in "Engineering News," July 24, 1913, p. 146, was formally opened on Dec. 13, 1913.

A Severe Wreck occurred near Darnow, Austria, on Dec. 16. According to press dispatches, 30 persons were killed and 35 injured.

A Coal-Mine Explosion occurred on Dec. 16, in the Vulcan mine of the Rocky Mountain Fuel Co., situated 70 mi. from Grand Junction, Colo. According to press dispatches 38 miners were killed.

A Bumper Was Torn Away, in the South Station of the New York, New Haven & Hartford R.R., at Boston, on Dec. 16, by a car. The car broke through the wooden gates and came to a stop on the concrete concourse where it caught fire from the explosion of its gas tank.

A Railroad Tunnel Collapsed, near Chemnitz, Germany, on Dec. 15, due to a slight earthquake, according to press dispatches. A passenger train from Roswein to Chemnitz was passing through the tunnel at the time of the cave-in. The locomotive and six cars were buried beneath the débris; eight persons are reported killed and 34 injured.

The Hetch Hetchy Bill, giving San Francisco needed rights for carrying out its plans for a gravity water-supply from the Tuolumne River, passed the United States Senate on Dec. 6 by a vote of 43 to 25. It passed the House by a vote of 183 to 43 on Sept. 24, 1913, and went to President Wilson on Dec. 7. He had not signed or vetoed it on Dec. 17; the ten-day constitutional limit expires on Dec. 18. An illustrated description of the Hetch Hetchy project, based on the voluminous report of John R. Freeman, was published in our issue of Dec. 26, 1912.

A Block Signal System was ordered installed on the Whitestone Division of the Long Island R.R., by the Public Service Commission of New York, on Nov. 26. The system is to be of the manually operated electrically controlled type. The order is the outcome of an investigation and report by Chief Inspector of Safety Appliances Belknap of the Interstate Commerce Commission, following the head collision which occurred on the Whitestone Division on Sept. 22 ("Engineering News," Sept. 25, p. 635), 600 ft. east of the College Point station, when three employees and one passenger were killed and 44 others were injured. The following statement is contained in the Chief Inspector's report.

This accident was caused directly by the failure of Towerman Maize to hold the east-bound train from New York to Whitestone Landing at JC Tower, until the arrival of the west-bound train, which was already overdue and which was superior by direction; but behind this error, upon the part of the towerman, was a dangerous method of train operation, for which the operating officials of this railroad were responsible.

The report further states that in July, 1913, Superintendent Austin recommended that a block system be installed on the Whitestone branch. General Superintendent Thornton stated that on account of construction work then in progress, it was deemed advisable not to install the system at that time. The subject was brought up again in September, and on Sept. 16, Mr. Thornton wrote to General Manager McCrea, requesting authority to install a manual block system on this division. This authority was granted on Sept. 18 and received by Mr. Thornton the next day. At noon, on Sept. 24, two days after the accident, such a system was placed in operation. In response to the order of the Public Service Commission, this block system will be replaced as soon as possible by a manually operated electrically controlled system.

The Granting of Licenses to Builders, by the Board of Examiners in the Building Department of Boston, Mass., will be under three classifications (fully discussed in "Engineering News," Oct. 2, 1913, p. 640) as follows:

(a) Charge or control of the construction of first-class buildings; (b) charge or control of the construction or alteration of second-class buildings; (c) charge or control of the construction or alteration of third-class buildings; (d) charge or control of the moving or shoring of buildings or structures; (e) charge or control of the tearing down of buildings or structures.

According to the November "Monthly Letter" of the Secretary of the Master Builders' Association, Building Commissioner Everett states that he understands that a man licensed under class (a) may take charge of work under classes (b) and (c), and one licensed under (b) may have charge of work under class (c). In his judgment, in many cases a man with a class (a) license might have charge of the work of classes (d) and (e). The commissioner also judges "that the usual practice would be to appoint one man who should be in control from the beginning to the end of any complete piece of work. If, for the convenience of the owner or builder, it is desirable to divide the work, say, by making the foundations, the steel frame, and the remainder of the work, each a part by itself, he may place a qualified and licensed man in charge of the foundations, another in charge of the erection of the steel frame, and still another in charge of the remainder of the work. The commissioner holds that the person in charge may, in his discretion, leave the work, when he judges it safe to do so, and he holds that subcontractors do not need to have a licensed man in charge if the general contractor has such. He says, "I do not understand that each subdivision of the work shall be in charge of a licensed person, but that it will be the duty of the person in charge of the whole work to see that the several parts are performed in a safe and proper manner."

Electric Power will be used exclusively for construction work on the Sun River irrigation project of the U. S. Reclamation Service in Montana. A 70-mile 110,000-volt transmission line has been built, from the Rainbow Falls plant of the Great Falls Power Co. on the Missouri River, through the entire length of the Sun River Valley to the diversion dam. Three transformer stations will step down for lower-voltage transmission to the principal points of work. A 44-mile government distribution line will extend along the Pishkun Reservoir and the Sun River slope canals. The power company is to extend the transmission line 30 miles, entirely across the project, to make energy available at each town on the three new railway lines projected. Electric power is already being used for pumps, compressors, concrete mixers, derricks and lighting at the diversion dams. Contractors for the main canals and laterals are having special electric-power shovels and drag-line scrapers designed for this work.

A Falling Steel Shaft Sank a Ship, in the East River, on Dec. 8. An 18-ft. shaft, being shipped for Caracas, Venezuela, on the Red D steamship "Zulia," lying at Pier 11, Brooklyn, N. Y., tipped vertically as it was swung over the cargo hatchway, and broke through the end of its wooden casing, tearing a hole in the bottom of the ship. After a seven-hour fight, the "Zulia" sank in 25 ft. of water.

The International Building Exposition, held in Leipzig, Germany, during the past summer, has announced its awards, and these include three American engineering organizations and an American engineer. The Alsace-Lorraine prize was awarded the Board of Water Supply of New York. The gold medal of the city of Leipzig was awarded to Gustav Lindenthal, the American Bridge Co., and the Strauss Bascule Bridge Co. Mr. Lindenthal, in connection with the American Bridge Co., exhibited plans of the Hell Gate Bridge, etc., while the Strauss company exhibited models and photographs of its bascule and lift bridges.

Artificial Marble Made with White Portland Cement as a base has been developed by the Art Stone Co., of Waynesboro, Penn., and very beautiful samples of the material were shown by the inventor of the process at the recent American Road Congress in Philadelphia. The process is applicable for making artificial ornamental tiling for use in any place where colored marble tiling would be applied. It is claimed that as mineral colors are used, the surface is permanent and will not fade on exposure to the light. The coloring is used in the surface only, the body of the tile being made up of ordinary cement. In order to secure a smooth, polished surface on the material, the tile is cast with its face against a sheet of glass.

The Connection of the Last Two Headings of the Canadian Northern Ry. tunnel under Mount Royal, Montreal, Que., on Dec. 10, was celebrated by the passage of a party comprising railway officials, engineers and other prominent citizens of Canada, from the west portal to the Dorchester St. Shaft, on the first "passenger train" to go through. The trip consumed 1 hr. 15 min. "The Montreal Tunnel and Terminal" was fully described in "Engineering News" of July 10, 1913, p. 62, by S. P. Brown, Managing Engineer, Mackenzie, Mann & Co. The first heading was started on July 8, 1912, at the west portal; after about 17 months the last two headings are joined. The tunnel is about three miles long.

End of Criminal Prosecutions Which Followed the Austin (Penn.) Dam Failure—A press dispatch from Coudersport, Penn., dated Dec. 9, reads as follows:

The last of the criminal prosecutions against officers of the Bayless Pulp & Paper Co., of Austin, Penn., growing out of the flood which devastated Austin, Sept. 30, 1911, destroying 80 lives and $3,000,000 in property were dismissed here today by Judge Ormerod.

Private prosecutors presented petitions requesting the step on the ground that they believed there could be no conviction of the defendants for voluntary manslaughter.

Settlements of the civil actions for damages against the company on a $150,000 basis opened the way for the dropping of the criminal cases.

The indictment of manslaughter in the second degree against George C. Bayless was dismissed at Wellsboro, N. Y., on Nov. 25 (noted in "Eng. News," Dec. 11, 1913, p. 1208).

A Long Girder Span Replacing a Howe Truss was put in place on the Duluth, South Shore & Atlantic Ry., at its crossing over Bad River, near Shilo, Wis., on Nov. 16. The Howe truss span was 150 ft. long and formed part of a timber trestle 955 ft. long. The entire structure was replaced by a plate-girder viaduct of 30-ft. tower spans and 64-ft. intermediate spans, with a 121-ft. deck plate-girder river span. This span complete weighed 108 tons. It was riveted up on two flat cars which were run onto the deck of the old span. The span was lifted off by a derrick car at one end and a gallows-frame hoist at the other end, the cars were run out, the deck of the old bridge torn away, and the new span lowered between the old trusses onto the previously erected steel bents. W. W. Walker is general manager of the Duluth, South Shore and Atlantic. E. R. Lewis is assistant to general manager in charge of engineering. The American Bridge Co. built and erected the new viaduct.

A Producer Gas Plant for power and lighting purposes will be a feature of the new type-foundry and printers supply plant of Barnhart Bros. & Spindler, Chicago. The machinery will be motor driven, and there will be a complete gas plant, not only for operating the generators, but for supplying 112 gas burners. Fuel gas will be used for the type-casting machines, heaters, hardening furnaces, brazing torches, stoves, annealers, lead and plating baths, etc. There will be two anthracite producers of 350 hp., two gas-engine generator sets of 150 and 75 kw., a 75-hp. electric welding set, electric coal-handling machinery, gas exhausters, etc. The larger engine is of the four-cylinder twin-tandem type, and the smaller one of the single-tandem type. They are guaranteed not to exceed 2% in speed variation between no load and full load.

Federal Power over Public Lands is held supreme over state jurisdiction by a recent decision of the Eighth U. S. Circuit Court of Appeals. In this case, the United States sought to enjoin the Utah Power & Light Co. from occupying certain lands in the Coche National Forest of Utah until it should comply with regulations of the Department of Agriculture. The company claimed the right to its occupancy under state authorization and in accordance with the famous Act of July 26, 1866, now Section 2339 of the Revised Statutes. This old act, it will be recalled, was passed to end the widespread troubles of trespass which miners and others had brought by their pioneer operations in the far West, and provided that, wherever rights to use of water had become vested by prior possession and had been recognized by local customs and laws, the possessors should be protected in their vested rights. The court held that: (1) the Act of May 14, 1896, empowering the Secretary of the Interior to fix regulations for the use of public lands in generating and distributing electricity, repealed the Act of July 26, 1866, as far as the latter related to this subject; (2) the company was not protected by tenure under state law since (a) state sovereignty did not transcend the constitutional power of Congress and (b) in the stipulations of the act enabling the people of Utah to form a state government and in the state constitution all right and title to unappropriated public lands was renounced; (3) the restriction of the Act of 1866 by the Act of 1896 became effective before the initiation of the company's claim.

PERSONALS

Mr. T. T. Richards has been appointed Sales Manager of the Wagner Electric Manufacturing Co., St. Louis, Mo.

Mr. P. St. J. Wilson, State Highway Commissioner of Virginia, has been appointed Assistant Director of the United States Office of Public Roads, Washington, D. C.

Mr. George P. Coleman, Assistant Highway Commissioner of Virginia, has been made Highway Commissioner, succeeding Mr. P. St. J. Wilson, resigned, as noted above.

Mr. Frank H. Villie, Civil Engineer, of South Bethlehem, Penn., and Borough Engineer of Fountain Hill, Freemansburg and Northampton Heights, has been appointed City Engineer of South Bethlehem, effective Jan. 1.

Mr. D. O. Thomas, of Belleville, Mo., has been appointed Highway Engineer of St. Clair County, Mo., at a salary of $2000 per annum. The position is under the state civil service and the term of appointment is for six years.

Mr. J. W. Lusk, former General Counsel of the Chicago & Great Western R.R., and afterward President of the German-American Bank of St. Paul, Minn., has been appointed Receiver of the St. Louis & San Francisco R.R., succeeding Mr. T. H. West, resigned.

Mr. Charles F. Murphy, former Superintendent of the Great Northern Ry., at Great Falls, Mont., and recently Superintendent of Transportation of the Butte, Anaconda & Pacific R.R., has been promoted to be Superintendent, succeeding Mr. Martin F. Kolbe.

Mr. Charles Corner, M. Inst. C. E., M. Am. Soc. C. E., Chief Engineer of the Beira & Mashonaland & Rhodesia Rys., Bulawayo, Rhodesia, has been granted an extended leave of absence, prior to his retirement after 15 years' service, during which he has twice had occasion to act as General Manager.

Prof. E. J. McCaustland, M. Am. Soc. C. E., of the University of Washington, Seattle, Wash., has been appointed Consulting Engineer of Highway Department of King County, Wash., which is about to spend $3,000,000 on road improvements. Prof. McCaustland is also a member of the State Board of Health.

Mr. Z. W. Kent, who has been Engineer in charge of building erection for the Berger Manufacturing Co., Canton, Ohio, has been appointed Service Director of Canton, which means practically City Engineer. The salary is $2000 per annum. Mr. Kent is 36 years old and has had 15 years' experience in engineering work.

Mr. C. C. Anderson, Superintendent of the Northern Pacific Ry. coal mines at Deer Lodge, Mont., has been appointed General Manager of the Northwestern Improvement Co., Tacoma, Wash., effective Jan. 1, succeeding Mr. Clarence

ft. Cleghorn. Mr. Anderson will have charge of the operation of the Roslyn, Ravensdale and other coal mines in the Northwest.

Mr. Siegfried Cederstrom, of New York City, has been appointed to a newly created position under the Public Service Commission, First District, of New York. This office is Real-Estate Expert and the duties are the handling of disputes with property owners over property condemned for new subways. The position was exempted from civil-service rules. The salary is $6000 per annum.

Mr. W. K. Walker, General Roadmaster of the Missouri Pacific Ry., at Wichita, Kan., has been made Engineer-in-charge of the South Omaha, Neb., improvements of the railway, about to be undertaken. These improvements consist of a viaduct and railway yards to cost over $1,000,000. Mr. Walker is a graduate of Mississippi State College, class of 1902, and began his railway experience as a track apprentice on the Vicksburg division of the Yazoo & Mississippi Valley R.R. He was appointed Assistant Engineer of the Missouri Pacific Ry. in 1905, and was promoted to be Division Engineer in 1908.

Mr. Alfred H. Smith, Vice-President of the New York Central Lines, has been elected President to succeed Mr. William C. Brown, who is to retire Jan. 1, as noted in our issue of Nov. 27. Previous to October, 1890, Mr. Smith was a foreman of bridges of the Lake Shore & Michigan Southern Ry., he was then promoted to be Division Superintendent and in April, 1901, to be Assistant General Superintendent. He was made General Superintendent in less than six months, and the following year General Superintendent of the New York Central & Hudson River R.R. Mr. Smith was promoted to be General Manager in 1903, and in 1906 was elected Vice-President.

Mr. H. M. Waite, City Engineer of Cincinnati, Ohio, has been chosen City Manager of Dayton, Ohio, at a salary of $12,500 per annum. Mr. Waite was formerly Superintendent of the Seaboard Air Line Ry. at Birmingham, Ala., and with the Clinchfield Coal Co., of Virginia. He was appointed City Engineer of Cincinnati in 1912, and has had charge of much important work in connection with the redesign of the city's sewerage system. Dayton is the first large city to offer the position of City Manager to an engineer. It is reported that an offer of $25,000 per annum was made to Col. George W. Goethals, M. Am. Soc. C. E., Chairman and Chief Engineer of the Isthmian Canal Commission.

Lieut. Frederick Mears, Assoc. M. Am. Soc. C. E., Chief Engineer of the Panama R.R. since 1909, has been appointed General Superintendent, succeeding Mr. John D. Patterson, resigned. Lieut. Mears was born in Omaha, Neb., in 1878. His engineering experience began in June, 1897, as a member of the engineering corps on the survey and construction of the Park Rapids extension of the Great Northern Ry. Later he was Assistant Engineer of the Kootnoi Valley R.R. He entered the United States Army in 1899, and in 1906 was assigned to duty at Panama as Assistant Engineer. He was appointed Resident Engineer of the Panama R.R. in 1907 and Chief Engineer in 1909. Under his supervision the Panama R.R. has been almost entirely reconstructed at a cost of $9,000,000.

Messrs. Charles T. Leeds and Wilfred K. Barnard, M's. Am. Soc. C. E., announce the formation of the partnership of Leeds & Barnard, Civil Engineers, with offices in the Central Bldg., Los Angeles, Calif. Capt. Leeds is a graduate of the United States Military Academy at West Point, class of 1903, and of the Massachusetts Institute of Technology, class of 1906. Until recently he was Captain in the Corps of Engineers, U. S. A., in charge of river and harbor work in Southern California. Mr. Barnard is a graduate of Sheffield Scientific School, Yale University, and has had several years' experience in railway engineering with the Pennsylvania R.R., the San Pedro, Los Angeles & Salt Lake R.R. and until recently he was Engineer of Maintenance-of-way and Structures of the Pacific Electric Ry.

Mr. A. M. Burt, Superintendent of the Northern Pacific Ry., at Spokane, Wash., has been made Chief Engineer of Maintenance-of-way, succeeding the late W. C. Smith. Mr. Burt was born in Syracuse, N. Y., in 1866, and was educated in the common schools of that city. He went West when still a boy and at 19 years entered the service of the Colorado Midland R.R. as a rodman. He was promoted through various engineering positions to be Division Engineer of that road, later serving in the engineering departments of the Northern Pacific Ry., the Wisconsin Central Ry., the Adirondack & St. Lawrence R.R. and the Chicago & Northwestern Ry. On Jan. 1, 1897, Mr. Burt was appointed Supervisor of Bridges and Buildings of the Northern Pacific Ry. Five years later he joined the operating department as Assistant Superintendent and in 1903 was promoted to be Superintendent.

Mr. Augustine W. Wright, M. Am. Soc. C. E., has resigned as member of the Board of Public Utilities, Los Angeles, Calif., as a result of a political disagreement over the rate fixed for natural gas, which had led to the retirement of the President of the board, Mr. O. O. McReynolds, M. Am. Soc. C. E. Some idea of the local point of view may be had from an editorial in the Los Angeles "Times" of Dec. 4, an extract of which is:

> The resignation of Mr. Wright yesterday deprived the city of the services of one of the ablest men that has recently been appointed to a municipal board; his very resignation demonstrated that he is not a cheap politician and cannot stand for the introduction of petty politics into municipal business. His disgust at the scalping of McReynolds, at the behest of a few political bosses, shows that he is the sort of timber of which we should build our municipal structure. His speedy going is significant and should cause Mayor Rose and his adherents at the City Hall to stop, look and listen.

OBITUARY

Thomas F. Ruhm, Naval Constructor, U. S. N., died in Seattle, Wash., Dec. 3.

Ira P. Carnes, founder of the Lima Locomotive Works, Lima, Ohio, died Dec. 10, at his home in Lima. He was born at East Barre, Vt., in 1850.

George Stilson, District Roadmaster of the Grand Trunk Ry., who was injured in a railway accident at St. Catharines about a month ago, died Dec. 5, at the General and Marine Hospital, Toronto, Ont., as a result of his injuries.

George Wellin, a young civil engineer employed by the Pittsburgh Construction Co., was killed by an electric shock while attempting to pass a derrick cable over some wires at the top of a transmission pole, at Kingsbridge Rd. and Jerome Ave., Borough of the Bronx, New York City, Dec. 13. He was 33 years old.

Henry Martin, Vice-President and General Manager of the International & Great Northern Ry., of Houston, Tex., was one of the fifty or more people who lost their lives in the recent floods in the Brazos Valley, Tex. Mr. Martin was drowned at Valley Junction while attempting to rescue other flood victims. He had gone there to personally direct the railway company's rescue forces.

William Deering, of Chicago, Ill., founder of the Deering Harvester Co., died at his winter home in Miami, Fla., Dec. 9. He was born at Paris, Maine, Apr. 25, 1826. After several years in business as a dry-goods commission merchant in Portland, Maine, he went West, became interested in agricultural machinery, and in 1870 formed the firm of Gannon & Deering, Chicago, out of which grew the Deering Harvester Co.

Dr. James MacAlister, for 22 years President of Drexel Institute, Philadelphia, Penn., died at sea while en route from New York to Bermuda, Dec. 11. He was born in Scotland, Apr. 26, 1840, and came to the United States in 1850. He graduated from Brown University in 1856 and from the Albany Law School in 1864. He was a school teacher for many years and was Superintendent of Schools of Milwaukee, Wis., from 1874 to 1881. Later he was Regent of the Wisconsin Normal Schools and in 1883 was made Superintendent of Schools of Philadelphia, Penn. This position he resigned in 1891 to become President of Drexel Institute.

Henry Shotwell Wood, M. Am. Soc. C. E., widely known as a hydraulic engineer and more especially as an expert in dredge work, died at his home in Glen Ridge, N. J., Dec. 5. He was born in Philadelphia, Penn., in 1860, and graduated from Swarthmore College in 1880. His early engineering experience was in bridge work, first with the Pennsylvania R.R., and later as Estimating and Designing Engineer of the Morse Bridge Co., Youngstown, Ohio. For 20 years, 1887 to 1907 he was with the San Francisco Bridge Co., which later became the Atlantic, Gulf & Pacific Co., for which he designed many notable hydraulic dredges; and during this period he established an international reputation as a dredge designer. Following 1907 he was for several years the Eastern representative of the North American Dredging Co., of San Francisco, Calif., and he had also maintained in New York City an office as Consulting Engineer. Mr. Wood was a member of the American Society of Mechanical Engineers, as well as the Civil Engineers. He is survived by a widow and a son and daughter.

Mitchell D. Rhame, for many years connected with the engineering department of the Chicago, Milwaukee & St. Paul Ry., died at his home in Minneapolis, Minn., on Dec. 9.

He was born Oct. 12, 1846, at East Rockaway, N. Y. He graduated from Yale in 1869 and then took a one-year post-graduate course at the Sheffield Scientific school. Upon leaving school Mr. Rhame entered the service of the United States Government as Assistant Engineer and was assigned to a survey of the Illinois River with headquarters at Peoria. While at Peoria, Mr. W. W. Folwell, President of the University of Minnesota, became interested in him and offered him the position of Professor of mathematics and engineering at that institution, which position he held from 1872 to 1880. After severing his connection with the University of Minnesota, Mr. Rhame entered the service of the Chicago, Milwaukee & St. Paul Ry., as Assistant Engineer, on Mar. 4, 1881, afterward holding the titles of Division Engineer from 1891 to 1905, Engineer of Construction, 1905 to 1908; and District Engineer, from 1908 to September, 1913, when he resigned on account of ill health. Among the more important works handled by Mr. Rhame during his connection with the Chicago, Milwaukee & St. Paul Ry. were the building of the South Minneapolis shops and terminal facilities, the construction of various new lines (Farmington to Mankato, Faribault to Zumbrota, Woonsocket to Wessington Springs, Bowdle, S. D., to the Missouri River), the revision and double tracking of the River division from St. Paul to La Crosse, and finally the construction of 200 miles of the Puget Sound line from the Missouri River to the Montana State line.

ENGINEERING SOCIETIES

COMING MEETINGS

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.
Dec. 29-31. Seventh annual convention at Chicago, Ill. Secy., I. W. Dickerson, Urbana, Ill.

AMERICAN ASSOCIATION FOR ADVANCEMENT OF SCIENCE.
Dec. 29-Jan. 3. Sixty-fifth annual meeting, at Atlanta, Ga. Secy., L. O. Howard, Smithsonian Institution, Washington, D. C.

SOCIETY OF CONSTRUCTORS OF FEDERAL BUILDINGS.
Jan. 5-7. Fifth annual convention at Washington, D. C. Secy., T. R. Maul, 409 P. O. Building, Philadelphia, Penn.

MINING AND METALLURGICAL SOCIETY OF AMERICA.
Jan. 13. Annual meeting at New York City. Secy., W. R. Ingalls, 505 Pearl St., New York.

AMERICAN SOCIETY OF ENGINEERING CONTRACTORS.
Jan. 16. Annual convention in New York City. Secy., J. R. Wemlinger, 13 Park Row, New York City.

AMERICAN WOOD PRESERVERS' ASSOCIATION.
Jan. 20-22. Tenth annual convention at New Orleans, La. Secy., F. J. Angier, Timber Preservation Co., Baltimore, Md.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 21. Annual meeting in New York City. Secy., Chas. W. Hunt, 220 W. 57th St., New York City.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
Jan. 21-23. Annual meeting in New York. Secy., E. A. Scott, 29 W. 39th St., New York City.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 27-29. Annual meeting in Montreal, Que. Secy., Prof. C. H. McLeod, 176 Mansfield St., Montreal, Que.

NATIONAL LIME MANUFACTURERS' ASSOCIATION.
Feb. 4-5. Annual meeting at New York. Secy., Fred K. Irvine, Chicago, Ill.

NATIONAL CONFERENCE ON CONCRETE ROAD BUILDING.
Feb. 12-14. Meeting at Chicago, Ill. Secy., J. P. Beck, 72 W. Adams St., Chicago, Ill.

AMERICAN CONCRETE INSTITUTE.
Feb. 16-20. Annual meeting in Chicago, Ill. Secy., E. E. Krauss, Harrison Building, Philadelphia.

American Automobile Association—At the recent annual meeting in Richmond, Va., John A. Wilson, of the Pennsylvania Motor Federation, and John N. Brooks, were elected President and Secretary, respectively. The next annual meeting will be held in Boston, Mass., on a date to be announced later.

International Conference on Safety at Sea—The work of the Conference, now being held in London, is still in the hands of committees and progressing very slowly. J. W. Alexander, Chairman of the United States delegation, is reported to have stated:

The American delegates are doing all in their power to push matters along. The committees are now beginning to make substantial progress, and I hope that the body of the work will be done before Christmas, leaving only details to be completed.

Society of Constructors of Federal Buildings—The 5th annual convention will be held at the Washington (D. C.) Architectural Club, in Washington, Jan. 5-7, 1914. The Society is composed of the Superintendents of Construction and other technical officers under the Supervising Architect of the Treasury.

American Wood Preservers' Association—At the 10th annual convention to be held in New Orleans, La., Jan. 20-22, 1914, 14 papers and 5 committee reports will be presented.

Association of Engineering Societies—Fred. Brooks, retiring Secretary of the Board of Managers, announces that Joseph W. Peters will succeed him, with offices at 3815 Olive St., St. Louis, Mo.

Fourth American Road Congress—The committee representing the American Highway Association and the American Automobile Association announces that the Fourth American Road Congress will be held in Atlanta, Ga., either Oct. 19-24 or Nov. 16-21, 1914.

Cleveland (Ohio) Engineering Society—The Society makes the following announcement:

In order that the Society may more effectively serve its members and friends, particularly those who are employers of engineering talent, or employees seeking positions, it has been directed by the Executive Board that calls from employers desiring engineering help, as well as from engineers desiring positions, will be received by the undersigned, either in writing or by phone and an effort made to render employment service. Such inquiries will be kept strictly confidential and the service rendered without charge to either party.

G. S. BLACK, Business Manager. DAVID GAEHR, Secretary.

New England Water-Works Association—The program for the monthly meeting held on Dec. 10 was so attractive that extra tables had to be set to accommodate those who came for the usual lunch in advance of the meeting. After some minor business and the announcement of the death of Horace G. Holden, one of the founders of the Association in 1882, a paper on "Rainfall" was presented by X. H. Goodnough, chief engineer of the Massachusetts State Board of Health.

The paper reviewed in some detail all the known early rainfall records in New England and presented tables and diagrams based on the rainfall data for the New England States available up to the close of 1912. The earliest rainfall record known was that of Prof. Winslow, of Harvard University, which covered rainfall at Cambridge, Mass., from 1749 to the Battle of Lexington. Other early New England records of rainfall, with the dates of their beginning, were: New Bedford, 1814; Boston, 1823; Waltham and Lowell, each 1825; Providence, 1830; Burlington, Vt., some time in the thirties. The highest recorded annual rainfall in New England was 83 in., on Mt. Washington, where observations were made fram 1871 to 1886.

A talk on the determination of the flow of water in pipes by observations on and computations from the differences in the velocities of the water at the outside and inside of bends was given by N. W. Akimoff, of Philadelphia. The subject was studied two years ago by Jacobs and Sooy, of San Francisco (see "Journal of Electricity, Water and Gas," July 22, 1911), and has been further studied by Mr. Akimoff.

A paper urging the more efficient operation of small water-purification plants was submitted by H. P. Letton, formerly an engineer for the New Jersey State Board of Health and now connected with the Federal Public Health Service. A number of instances were cited of the slackest sort of operation, in some cases involving an absolute waste of all or much of the money being expended. The remedy suggested was state approval of plans for water purification and monthly state inspection of operation. The author suggested that a number of water companies or municipalities might combine to obtain a competent supervisor of their plants, much as local boards of health have been coöperating in Massachusetts under the direction of Prof. Earle B. Phelps.

In discussing Mr. Letton's paper, Prof. Phelps said a difficulty in the coöperative plan just mentioned had been to get neighboring towns to work together. He suggested that state boards of health be empowered to approve the selection of a filter superintendent to operate several small plants, apportion the costs and receive and act upon the reports of operating results.

Prof. Geo. C. Whipple, in a written discussion, said that the need of supervision is as urgent for small as for large water-purification plants, but the unit cost is more. At small plants it is the laborer or low-salaried and inexperienced man who has his hands on the throttle. The need of state control was urged.

Owing to lack of time the proposed topical discussion on methods of locating underground leaks was postponed until the February meeting. The January meeting will be the annual meeting of the Association. All the monthly meetings are held at the Hotel Brunswick, Boston, on the second Wednesday of the month.

ENGINEERING LITERATURE

CONTENTS

	Page
EDITORIAL:	
Title-Page Dates	1263
CORRESPONDENCE:	
Efficiency of Turbine Blades. H. M. Martin	1263
REVIEWS AND NOTES:	
Indian Storage Reservoirs with Earthen Dams. Reviewed by Desmond Fitz-Gerald	1263
European Cities at Work	1264
Civil Engineers' Pocket-Book	1264
Specifications and Tables for Steel-Frame Structures	1264
The Theory and Practice of Heating and Ventilation. Reviewed by D. D. Kimball	1265
Water Purification and Sewage Disposal	1265
Mine Surveying. Reviewed by L. D. Tracy	1266
American Railroad Economics—Railway Problems	1267
Pocket Companion	1267
Sewer Design	1267
Workmen's Compensation and Industrial Insurance under Modern Conditions	1267
The Resistance of the Air and Aviation—Leitfaden der Flugtechnik. [Contributed]	1268
Royal Commission on Sewage Disposal	1269
Principles of Irrigation Engineering	1269
Handbook on Sanitation	1269
The American Office. Reviewed by H. L. Gantt	1270
The Catskill Water-Supply of New York City	1270
Elements of Water Bacteriology	1270
International Association for Testing Materials	1270
Shop Mathematics, Part II.—Shop Sketching. Reviewed by R. R. Potter	1271
Agricultural Drafting	1271
Power-Plant Testing	1271
Preservative Coatings for Structural Materials: Committee Reports of American Society for Testing Materials, 1903-13	1271
Treatise on Roads and Pavements	1271
Alternating Currents and Alternating-Current Machinery. Reviewed by Ernst J. Berg	1272
Reinforced-Concrete Construction, Vol. II	1272
The Soldier's Foot and the Military Shoe	1273
PUBLICATIONS RECEIVED	1273

EDITORIAL COMMENT

With this issue the monthly engineering-literature section of this journal begins its eleventh year.

Title-Page Dates

For a variety of reasons which it is unnecessary to enter into it here, some book publishers have been in the habit of changing the title-page date of their books at each new printing, regardless of whether or not the book has been given the slightest revision. However strong the arguments may be for this plan, the practice of it often leads to disappointment on the part of such purchasers as are not wary enough to check the title-page date by the copyright date or the date and wording of the preface. The purchaser and reader of a book, and in the long run the publisher as well, will be better served if the book indicates unequivocally and conspicuously just when the original edition was written and published, and whether each new printing is from the old plates unchanged, slightly changed, thoroughly revised, or wholly re-written and re-set. Publishing a 1910 book with a 1913 imprint may not be an attempt at deception but it often does deceive for a longer or shorter time—only to make a person angry when the facts are found out.

CORRESPONDENCE

Efficiency of Turbine Blades

Sir—With reference to Mr. Longwell's review of my book on "Steam Turbines," in your issue of Oct. 16, 1913, I gather that he has not fully understood the reference to the Parsons' form of blade having shown, "as applied to aëroplanes," a higher efficiency than simple bent plates of uniform thickness.

The fact of the matter is that some 20 to 25 years ago Horatio Phillips experimented very largely with steam-driven "aëroplanes" of rather a special type. They were neither monoplanes, biplanes nor triplanes, but multiplanes, the supporting surface consisting of 30 or 40 narrow strips arranged in a frame one above the other. The whole system of supporting surfaces was therefore exactly analogous to a row of turbine blades. He made many experiments to determine what form of blade gave the highest ratio of lift to drift, and finally arrived at a form similar to that which was afterward adopted in the Parsons turbine. In his experience this proved distinctly superior to the mere bent plates of uniform thickness, with the straight tails which are so dear to the mere computer, who loves to have definite angles. Some experiments made here, in which steam was passed through a set of Parsons blades and a set of blades with straight tails showed that this steam was delivered with distinctly more turbulence in the latter case. This confirms the original conclusion of Mr. Phillips, and is exactly what one would expect from theoretical considerations.

H. M. MARTIN.

26 Adiscombe Road, Croyden, England, Oct. 30, 1913.

REVIEWS AND NOTES

Earth Dams in India

Reviewed by DESMOND FITZGERALD*

INDIAN STORAGE RESERVOIRS WITH EARTHEN DAMS. A Practical Treatise on Their Design and Construction—By William Lumisden Strange, M. Inst. C. E. Second and enlarged edition. London, England. E. & F. N. Spon. New York: Spon & Chamberlain. Cloth; 6x9 in.; pp. xxiv + 442; 59 text illustrations and 16 plates. 21s., net.

Although the practice described in this work differs materially from that usually followed in this country, there are many points of general resemblance. The care which the author has taken to make his points clear, both in text and illustrations, will probably result in giving the work a place in many libraries in the United States.

The first part of the book deals with such questions as the Selection of the Site, Rainfall and Runoff, Storage Capacity, Surveys, etc. These are elemental and must necessarily be familiar to practicing experts of every nation.

Chapter II reviews the dam embankment and is of importance as in it is developed the general type and dimensions of the cross-section; the remainder of the book is devoted largely to an amplification of the details of construction. Ordinary English practice includes a central puddle wall; recent practice in Bombay enlarges this clay hearting to such an extent that it occupies practically the greater mass of the embankment. The old dams in India had no core walls and were of homogeneous section; they were composed of "pure black cotton soil," which was water-tight. As this material was found to be slippery, leading to slides, the author in his plans has weighted it on both inner and outer slopes with heavy shaly soil, with slopes of 1 on 3 on the water side and 1 on 2 on the outer side. Finally he recommends using a soil of the same character uniformly throughout the dam, but he does not rely upon its water-tightness, but selects or makes one that is impervious and stable under action of water. The proportions advised are one part of "cotton soil" or other clayey soil to one of "murum" or shale.

*Consulting Engineer, Brookline, Mass.

The subject of settlement is one which deeply interests all engineers who build earth dams. The author states that in a well consolidated dam the settlement should vary from one-thirtieth to one-thirty-sixth of the total height. In a dam of 90-ft. height, therefore, the settlement should be 3 ft. To an American engineer this certainly seems enormous. In dams built by the reviewer for the city of Boston and others the settlement for a height of from 60 to 80 ft. has seldom exceeded 1 in. and has sometimes been less than that amount, and masonry structures have in some cases been built upon them without serious cracks. In England, however, the usual settlement is from 1 to 2 ft., but these embankments are formed in a very different manner from those included in the best practice in this country. There is nothing like an embankment largely composed of gravelly materials rolled in 4-in. layers, while slightly moist, and furnished with a concrete core-wall.

Chapters III and IV take up the problems of the waste weir and the outlet—two subjects to which any designer must give the closest study, for it is safe to say that almost all earth dams which have failed have done so from improper waste weirs or outlets. In other words, water has topped the dam or followed some weakness in the outlet. In fact to engineers of wide experience it must always be a matter of wonder that earth embankments, when built as dams or longitudinally as levees or dikes to prevent overflow, are as a general rule so stable even under adverse conditions. On one occasion the writer was witness to a high dam built by dumping and consolidated by water under pressure from a fire-hose, which showed an excellent section, free from any cavities or other faults when it was opened for examination.

Safe automatic overflows and sound outlet construction are essential features in connection with earth dams. For many reasons it may be questioned whether the favorable attitude of the author toward the use of a stepped waste weir will be followed in this country. It has been designed in the examples so fully illustrated in "Indian Reservoirs" to meet some of the "objections" to a solid weir with permanent crest. It is true that the stepped weir "enables the length of the weir to be reduced greatly," but this very course is one which should be avoided. If there is any advice which should be hammered into the minds of constructors of earth dams, over and over again, it is to be careful to place a long, permanent overflow at a sufficiently low level to prevent the overtopping of the embankment.

In India, storage reservoirs are filled during the rainy or Monsoon season, June-October, corresponding to our summers. The rainfall thus concentrated yields a good percentage in the collections because it is not exposed to so much evaporation as if it were more equally distributed. The collection may be as high as 40%, nothwithstanding the great heat, while in New England it averages 50%.

EUROPEAN CITIES AT WORK—By Frederick C. Howe, author of "The City: The Hope of Democracy," and "The British City: The Beginnings of Democracy." New York: Charles Scribner's Sons. Cloth; 5x8 in.; pp. xi + 370; 11 illustrations; $1.75, net.

Mr. Howe has long been an earnest student of municipal problems with the admirable object of learning for himself and then teaching others how city government and governors may best serve the citizens and contribute to the upbuilding of the people. Among other and earlier books he has written "The British City; the Beginnings of Democracy," and "The City: The Hope of Democracy." His present work deals chiefly with German cities, but devotes considerable space to British cities as well, besides containing many references to the cities of other European countries.

German cities have the highest place in the regard of the author, both because they serve the people with most singleness and directness of purpose, and because they recognize the value of trained public servants. The democracy of the German cities is all the more remarkable, Mr. Howe thinks, because these cities are ruled so largely by men of affairs, chosen by a relatively few wealthy voters—notably in Prussia. In comparison, the British cities, while better governed than American cities, are ruled more generally by small tradesmen and by men who are directly or indirectly interested in what we should call public-service corporations, besides worshiping the land. Then, too, the British system of taxation on rental values, with taxes paid by the tenants, makes voters and officials alike very sensitive to rises in the tax rate, thus delaying municipal improvements.

Mention may be made of chapters on Town Planning and City Building, Housing, The Business Men Who Rule the German Cities and their Ideals, and of two chapters on municipal ownership in Great Britain. The final chapter is a comparison of The American and European City—to the advantage of the former. A few half-tone plates heighten the interest of the volume and bring home some of the teachings.

The book as a whole, like the earlier ones by Mr. Howe, is inspiring and suggestive.

Another Civil Engineers' Pocket-Book

CIVIL ENGINEERS' POCKET-BOOK: A Reference-Book for Engineers, Contractors and Students Containing Rules, Data, Methods, Formulas and Tables. By Albert F. Frye, M. Am. Soc. C. E., New York; D. Van Nostrand Co., London: Constable & Co., Ltd. Flexible leather; 4x7 in.; pp. xlii + 1611; illustrated. $5, net.

A civil engineers' pocket-book written by one man is rather a novelty, after the publication of a similar work by a large corps of authorities. The obvious deficiency of the one-man production is that, since one man rarely is familiar with all—or many—fields of engineering, it cannot be expected that he will do equal justice to all parts of his subject. In this respect the present work is in harmony with the rule: it is probably more unbalanced than any of the present handbooks now on the market. Samples of under-treatment are: A one-page chapter on Water Purification (and, indeed, most other municipal sections); and a six-page chapter on tunneling, which does not deal with earth tunneling. We refrain from citing cases of over-treatment.

The most prominent feature of the work is its abundance of tables. In this feature—vitally important for a handbook—Frye's work stands out ahead of some other handbooks. There are few who will not find the book a good investment, for its tables alone.

The author claims a high degree of accuracy for his tables, probably with truth. Similar claims for the text would need to be circumscribed somewhat, as even our brief survey of the compendious work revealed various statements that will prove misleading, to say the least. These are largely in detail matters, though whether it is a detail matter that garbage crematory plants are said to be "sometimes self-supporting by reason of the residues of oil and grease" is open to question. The whole sewer section is decidedly unsatisfactory, in comparison to Railroads, or Surveying.

The plan of including references and reference-notes in each chapter is a good innovation. It is not ideally carried out, however, and is not uptodate. The latter is true, also, of the citations from the Joint Committee report, the National Electric Code, etc. Whether this may not be due to the publisher's delay in getting the book out we are unable to judge.

In brief, the new pocket-book contains much good matter not found in prior handbooks, as these contain much not included in Frye's work. It is not a cyclopedia of civil engineering, but is a useful compendium of tables and miscellaneous data.

SPECIFICATIONS AND TABLES FOR STEEL FRAMED STRUCTURES: Office, Warehouse and Manufacturing Buildings, Sheds, Docks and Structures Other Than Bridges. General edition, 1913. New York; American Bridge Co. Paper; 5x8 in.; pp. 60; illustrated.

This specification pamphlet is a handbook of considerable value. We understand that the company intends it for distribution to those interested, for instance, designers of structural steel; it may, therefore, be of use to summarize the contents here. The pamphlet is to be had at any of the contracting offices of the American Bridge Co.

Specifications for steel structures cover the first six pages. They are the company's specifications prepared for the use of its designers in cases where no outside specifications govern. The subject of design, general proportioning of parts, detailing and workmanship are included. Any engineer using these specifications will be apt to add to them considerably, as some matters which the ordinary specification includes are not represented in this one; what is given appears to be sound and progressive, however. Then follow 14 pages on I-beam tables, six pages being explanation of the make-up and method of the tables, the tables (uniform load, for various spans) occupying eight pages. The comments include instructions and cautions on some matters not directly concerned in the tables, as impact effect, lateral deflection, shear and web buckling. A formula for resistance to web buckling is given involving the assumption that any concentrated load is distributed over its own bearing width plus one-fourth the beam depth in case of an end lead, and one-half the depth in case of an interior load. The allowable vertical compression on the web on this basis is limited by a

column formula of initial value 19,000. There is also a page of sketches and detail figures on standard beam connections. Then follow two important sections: (1) A 16-page table of riveted plate-girders giving section modulus, weight per foot, etc., for a complete series of plate-girders from 24 to 48 in. deep; and (2) 12 pages on columns, also giving a series of selected sections and tabulating the permissible load for various lengths. A compilation of loading figures occupies the last three pages of the book.

Concerning the tables of plate-girders and columns we learn that the company endeavored to use sections that are standard and can be readily obtained, hoping to encourage designers to use such sections and thereby facilitate delivery. Some existing tables of the kind contain all (or nearly all) sections rolled, including unusual or infrequently rolled sections. When a designer happens to use such a unusual section there is apt to be either considerable delay in delivery or annoying negotiations until a substitution of an equivalent but more common section is agreed upon.

A British Book on Heating and Ventilation

Reviewed by D. D. KIMBALL*

THE THEORY AND PRACTICE OF HEATING AND VENTILATION—By Arthur H. Barker, Managing Director of J. F. Phillips & Son, Ltd.; author of "Graphical Calculus," "Graphic Methods of Engine Design," "Management of Small Engineering Workshops," etc. London: Sidney Carton & Co. Cloth; 7x10 in.; pp. xvi+640; 142 text figures and 33 tables. 25/-, net.

In this book the author has admirably succeeded in combining a discussion of the fundamental theory of the principles of heating and ventilation with common sense modifications thereof resulting in rules, formulas and graphic charts for the practical application of the science, largely based upon the author's experiments and practice.

The practical heating and ventilating man will appreciate the statement made almost at the beginning of the preface as to the variance between theory and practice. He will find the author's association of the two instructive, and the formulas and charts of practical value in his business. A sound knowledge of elementary mathematics only is required for an understanding of the calculations and formulas used. The student and engineer will find much that is new in the discussion of principles and practice, together with many new formulas and charts of real value.

Credit is given to Rietschel, Peclet, Weisbach, Recknagel and others for basic ideas on heating, and to Dr. Leonard Hill for statements regarding recent investigations into the problems of ventilation.

Especial attention is given to such subjects as the flow of fluids, conduction of heat and the theory of fans, and new charts are given to the application of the author's principles of low-pressure circulation of water. A simplification of Rietschel's theories of determining pipe sizes is undertaken, this being based upon extensive original experimentation.

The table of contents indicates a very thorough treatment of the problems as shown by such topics as the properties of matter, motion, energy, heat, air, water, steam flow of fluids, hygiene of ventilation, movement of air in and through a room, air required in ventilation, theory of fans, theory of transmission of heat, and practical application thereof, method of delivering heat to a room, emission of heat from radiating surfaces, temperature maintained in a building, combustion of fuel, boilers, chimneys, draft, heating and humidifying air, circulation in water pipes, pipe sizes in hot-water systems (theoretical and practical) including accelerated high-pressure systems, flow and distribution of steam in pipes, the plenum system, heating by fireplaces and stoves, and testing of heating and ventilating plants.

A complete list of units of measurements essential to the work of the heating engineer, with definitions thereof, is given in the first chapter. Elaborations of this, and further definitions of terms and elucidations of principles are in the four chapters following. These are amply sufficient to give the student a thorough understanding of the fundamental facts upon which is based the theory and practice of the science of heating and ventilation.

Chapter VI, on the Hygiene of Ventilation, is written in the light of recent investigations and experiments but takes definite positions on some questions which, at best, may be said to be, as yet, debatable. Especially will the views stated on humidity, ozone and air washing be the subjects of arguments. This chapter includes many valuable physiological data and information, even if subject to the possible criticism that it is in some details indefinite and in respects does not give consideration to certain views held by able investigators. It forcibly points out the relations of the engineer and the hygienist and the difficulty of providing ventilation to satisfy every person in a heterogeneous assemblage.

The succeeding two chapters on the movement of air through and in a room give evidence of study and successful practice on the part of the author. Chapters IX and X describe in detail methods of calculating air and other quantities in ventilation, with new information on air leakage.

The next chapter is a condensed but very interesting study of the theory of fans, their efficiency and calculation. The chapter on heat transmission gives some old data, as it should, but also many new data and several charts, which are valuable.

Chapter XIV, on the Determination of the Heat lost from a Room, is along the well known lines.

The next chapter, on Methods of Delivering Heat to Rooms, is chiefly notable as an argument in favor of the use of the hot-water system in preference to the steam system. The author is evidently not familiar with the use of fractional valves for the control of the admission of steam to the radiator, or other features of the best American practice. Certainly hammering and other noises are not necessary with modern steam-heating equipment.

Chapter XVI, fully but in familiar terms, covers the subject of emission of heat from radiating surfaces.

Chapter XVII, Temperature Maintained in a Building; XVIII, Combustion of Fuel; XIX, Boilers; and XX, Chimneys and the Control of Draft, are much in line with American practices, and contain some good charts. No attempt is made to discuss the different types of boilers.

Chapter XXI, on the Heating and Humidifying of Air for Ventilation, is principally devoted to the latter phase of the subject, in which it fails entirely to approach the level of American practices. The author fails to give evidence of any acquaintance with the type of air washers used in this country and their possibilities in humidification.

Chapters XXII to XXVII inclusive, cover thoroughly the subject of hot-water piping systems of all kinds. New charts are given, the practicability of which only experience could demonstrate.

Chapers XXVIII to XXX are on steam systems, but from the standpoint of American practices, lack completeness and practical simplicity.

The first portion of Chapter XXXI would bring objections from our engineers who would maintain that the objections lodged against the plenum system have been eliminated in our practice. A study of American practice would make possible a material improvement of this chapter. In fact the practice of ventilation is altogether too briefly treated in this book. Chapter XXXII on fireplaces and stoves is brief and of no special importance. The final chapter covers, in an interesting way, many details of testing heating apparatus and its parts.

The appendix includes many interesting tables which are of value to the heating and ventilating engineer. No part of the book is more complete or would make it more desirable.

Altogether the book is interesting and instructive, complete in many respects, but deficient in others, and not a specially notable contribution to the science of heating and ventilation.

WATER PURIFICATION AND SEWAGE DISPOSAL—By Dr. J. Tillmans, Director, Chemical Department, Municipal Institute of Hygiene, Frankfort-on-Main. Translated by Hugh S. Taylor, University of Liverpool. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. xv + 143; 21 illustrations. $2 net.

The two brief essays composing this book present a good outline of water and sewage treatment from the viewpoint of a German laboratory man who has apparently relied upon the writings of others for a large part of both the data and the opinions which the book contains. Within the limits indicated, the book will be useful to those this side of the Atlantic who wish to be informed on water and sewage treatment from all viewpoints.

Some new or at least unfamiliar practices are brought out, notably the use of fishponds for sewage treatment and the application of sewage to small sewage farms by means of hand hose. Each of these methods is used on a small scale and receives but a few lines in the book.

While the viewpoint is essentially German some references are made to British and American authorities. Naturally, the author appears to be more familiar with British than with American practice. While mentioning the extensive use of hypochlorite disinfection of water in the United States, he makes no reference to American studies and use of the same agent for sewage treatment here, although writ-

*Richard D. Kimball Co., 15 West 38th St., New York City.

ing of the use of heavy doses of chloride of lime for sewage treatment in Germany.

The subject is presented in a logical and readable way and the work of translation seems to have been well done, except for an occasional apparent unfamiliar term, perhaps due to a too literal translation.

Mine Surveying

Reviewed by L. D. TRACY*

MINE SURVEYING—By Edward B. Durham, Associate Professor of Mining, University of California. New York and London: McGraw-Hill Book Co., Inc. Flexible leather; 5x8 in.; pp. vii+391; 211 text illustrations. $3.50 net.

There are a number of works published on Plane and Higher Surveying, but the field of Mine Surveying has not been so well covered. Therefore, any well written book which deals with this subject is welcome. In "Mine Surveying," Prof. Durham has made a distinct addition to the library of the mining engineer.

He commences his book with a brief but lucid description of the adjustments of the principal instruments used in surveying. He makes a note of the fact that especial care should be taken of those instruments used in underground work, as they are so much more liable to accumulate dirt and get out of adjustment than are those used in surface surveying. The language used is terse and to the point, and can be easily understood. The second part of the chapter is devoted to a brief but comprehensive discussion of general surveying methods. The author does not go greatly into detail, for the reason given in his opening paragraph, "The general methods of caring for, adjusting and using them (the transit and level) are described in all books on plane surveying." The chapter as a whole, is clear and concise, and will refresh the memory of anyone who may have become rusty upon some of the fundamental principles of surveying.

The next chapter is given almost wholly to a description of the equipment used in making underground surveys, and while interesting, yet its place in a book of this character is hardly obvious, for the reason that an engineer having responsible charge of a mine survey, would in all probability have had sufficient experience in practical work to know what instruments would be necessary for such a survey, and if he did not know, it is very doubtful whether anyone having responsible charge of a mine would engage him to do the work.

It seems to be an utter waste of time and space to describe, for instance, the kind of clothes, etc., that a surveyor should wear when making a mine survey, as the author does in this chapter. The same space might far better be devoted to more necessary things. For instance, a discussion of the problems met in staking out mining claims, together with a brief treatment of the laws governing the patenting of such claims, a subject discussed in but few books and which is ignored in this. Yet this very subject of mining claims plays an important part in a mining engineer's work. About the only real useful portion of this chapter is the subdivision entitled "Station Marks." This subdivision gives some really valuable information regarding the marking of survey points in underground work.

Chapter III deals with some of the methods used in making a skeleton survey in mines, especially in those having more or less of a slope. The explanations are exceptionally clear and the diagrams used as illustrations well chosen.

The succeeding chapter supplements this by describing the manner in which the details required to complete the map are obtained and tied on to the skeleton survey. There are several pages of illustrations showing the different forms of field notes. It is a common fault with engineers, that having once devised a system of their own for this work, they are loth to change, believing that their way cannot be improved upon. Yet these two chapters may be very profitably studied by any engineer.

Chapter V is devoted to the calculation of field notes and their reduction to a form, convenient for plotting. A very useful feature of the chapter is the manner shown in posting in a permanent form the results of the calculations, that they may be filed away for future reference. Many samples of blank forms are shown which may be used for these records.

The succeeding chapter gives a description of the detailed work of mine mapping and platting. The methods given follow closely the general practice of mining companies and many samples of mine maps of different types are shown. The paragraph "Care of Maps" might well be read and heeded by many officials of mining companies who will expend a large sum of money in the preparation of such maps and then let them lie around and become utterly unfit for use. The reviewer has heard of one high official of a large company w[ho] was accustomed to spread a large plan, prepared with gr[eat] care, upon the floor and then walk over it, pointing with t[he] end of a cane to parts about which he was talking.

Chapter VII is devoted to "Special Mine Surveys" a[nd] takes up in detail the surveys made in anthracite and bit[u]minous coal mines. The reviewer does not agree with Pr[of.] Durham in his method of numbering survey stations with co[n]secutive numbers. The reviewer much prefers the method us[ed] in railroad surveys in which every 100 ft. is counted as a statio[n]. For instance, a point 658 ft. from the beginning of an entr[y] being Station 6+58, the first station at the beginning of th[e] entry being Station 0+00. This avoids repetition through a[n] oversight of the same number, at the same time giving at [a] glance the distance that the entry has been driven. The latte[r] part of the chapter contains a well written description of th[e] different instruments used in determining the cross-section o[f] tunnels, entries and shafts, together with the manner of calculating the cubical contents of the volume of material removed.

Chapter VIII is an exceptionally good chapter upon special problems in surveying which are of almost daily occurrence to the mining engineer. For instance, the location of a particular point on the surface from which to sink a shaft or to drive a bore hole, in order to meet a given point in the mine. Prof. Durham's manner of explaining these problems is exceedingly clear and concise and the cuts used in illustrating the problems are easily understood. The author is to be commended for omitting the complex mathematics with which many professors of engineering are prone to burden their books, and through which the average engineer in the field hesitates to wade.

In Chapter IX is a unique and interesting description of the methods used in early times preceding the development of the modern precise surveying instruments. The chief value of the chapter, however, is in indicating what may be done in surveying by primitive methods and ingenious home-made contrivances. Many young engineers, especially those just out of a technical school, where they have had the benefit of a complete equipment, obtain the idea that it is absolutely necessary in actual work to have the same elaborate outfit to which they have been accustomed in college. It is by no means the exception, however, that the mine manager often considers the engineering department as a necessary evil and as an additional overhead expense which should be cut down as much as possible and, therefore, furnishes only a meager equipment, and the engineer is thrown on his own resources. This chapter should prove of great benefit to one placed in this position, or to one who, far from headquarters, has had an accident happen to his instrument without any means of repairs.

The succeeding chapter is given to the treatment of special equipment used in mining work, such as transits with double telescopes, eccentric standards, etc., together with an explanation of their adjustments and use. The criticism contained in this review of the second chapter does not apply in this instance, because in that chapter the instruments referred to are so well known, while in this chapter those described are especially for mining work and their uses are not so well understood.

The next chapter is one of the most valuable and useful in the book, treating, as it does, one of the most important, yet one of the most difficult operations in mine surveying, that of shaft plumbing.

Prof. Durham goes into this subject quite in detail, citing several examples of deep-shaft plumbing, notably the shaft of the Tamarack mine which is about 4300 ft. deep. The reviewer has seen no better treatment of the subject anywhere than is given in this book.

In logical sequence to the preceding chapter follows one on "Tunnel Surveying," which treats in the same thorough manner Mine Tunnels, Aqueducts, Subways and Subaqueous Tunnels. Especially important is the author's treatment of curved tunnels. In this chapter advantage has been taken of the experience gained in the construction of the Simplon Tunnel in Europe and of the Hudson River Tunnels, the New York Subway, the Croton Aqueduct and many other engineering accomplishments in this country.

Passing over Chapter XIII, which is devoted to the construction of surface and mine models, we come to an extended chapter upon exploratory surveys. This chapter describes the manner in which ore veins are traced, their dip and direction and the apparatus used in the work. Also the making of assay maps and those showing geological formations. The last chapter is closely allied to the preceding one, taking up, as it does, the subject of magnetic surveys for iron-ore deposits.

Prof. Durham has gathered together a large amount of valuable information. The reviewer has not seen any book which surpasses it in the treatment of the subject, or in general

*245 Fourth Ave., Pittsburgh, Penn.

arrangement, clearness and brevity of statement. This latter quality is especially appreciated by the engineer who, in the field, desires to refresh his memory on some little point, and neither has the time nor patience to read through a lot of useless verbiage.

A review of this work would hardly be complete if it failed to mention the attractive appearance of the book, although if it could be made slightly smaller, without affecting the size of the type or affecting the ease with which it can be read, it would doubtless be appreciated by those for whose use it is intended. The volume is essentially a field book, and its present size makes it difficult to fit in the pocket.

Two Books on Railway Affairs

AMERICAN RAILROAD ECONOMICS: A Text-Book for Investors and Students—By A. M. Sakolski, Staff Lecturer in New York University School of Commerce, Accounts and Finance. New York: The Macmillan Co. Cloth; 5x8 in.; pp. xii+295. $1.25, net.

RAILWAY PROBLEMS—Edited, with an Introduction, by William Z. Ripley, Ropes Professor of Economics, Harvard University. Revised edition. Boston, New York and London: Ginn & Co. Cloth; 6x9 in.; pp. xxxiv+830; illustrated. $2.50.

The book by Prof. Sakolski is of an analytical rather than a statistical character. It deals mainly with the financial features of railway business (capital, revenue, rates, etc.), and only incidentally with the physical features (construction and equipment). The purpose of the book, as stated in the author's preface, is to assist in the correct judgment and proper understanding of railway activities and operating results. A comparison of statistics is not sufficient for such an understanding, unless the real meaning and relations of the statistics are fully realized.

In the short chapter on the economics of railway construction reference is made to the importance of reaching large cities, but nothing is said regarding the qualification to this general statement which is formed by the necessity of avoiding large cities by through lines of heavy traffic. In many cases such cities on trunk lines are now avoided by costly cutoff or diversion lines to keep the through traffic clear of interference by the congested conditions of lines in and near these cities. Further, it may be a question in many cases how far it is advisable to divert a line between two points in order to reach an intermediate point.

Another chapter deals with location, track and bridges, while a third deals with locomotives and rolling equipment, all in relation to operating conditions. It is hardly correct to speak of the Mallett locomotive as "the most advanced type in locomotive construction," without qualification as to its purpose, for it is a type adapted only to a special class of service under special conditions.

Traffic statistics and their meaning are discussed. Here it is shown how increased freight business is handled with decreased train mileage, due to the heavier train loading made possible by physical improvements. A considerable amount of space is given to railway accounts and their analysis from the accounting point of view. That is to say, the purpose and meaning of the several accounts are explained, together with their relation to operating conditions. This is followed by a general analysis of the principles and practice of railway finance, including capitalization and securities. Railway rates are discussed, with their basing systems and their regulation by governmental authority, and the author states that "the economic basis of railway rate making is that the charge for the service shall permit a profit both to the shipper (or passenger) and to the carrier."

The book by Prof. Ripley is in large part a compilation of matter relative to court decisions and proceedings in regard to rates, but this is supplemented by several chapters on special subjects by different authors. It is a revised edition of a book first published some six years ago and reviewed in our issue of July 18, 1907. We can again commend it to those who desire to study the economic relations of the railways and the public.

Of the 29 chapters there are 18 dealing with questions relating to freight rates, both in general and in regard to special or notable cases considered by the Interstate Commerce Commission and illustrating different phases of the rate problem. Among these chapters may be noted one on "The Regulation of Railway Rates under the 14th Amendment to the Constitution," by Hon. F. J. Swayze.

A deeply interesting chapter on "Early American Railway Conditions" records the vicissitudes of the early railways and their promoters. In view of the present agitation in Chicago with the object of consolidating the railway terminals, it is of interest to note that when railways first approached that city there was strong demand that each road should have its own tracks and station, so that Chicago might not become a mere way station on a through line. The darker side of railway history is shown in three chapters dealing with the early speculative and financial scandals of the Erie R.R., by Hon. Charles Francis Adams; the building and cost of the Union Pacific R.R. under its construction companies, by Henry K. White; and the Standard Oil Co. rebates, by Ida M. Tarbell. All these are reprints of matter previously published elsewhere but collected here to represent various phases of the railway problem.

A chapter by Henry Hudson describes the Southern Ry. & Steamship Association as a typical pool. Another by Balthaser H. Meyer deals with the Northern Securities Co.; this was a great "holding company" representing a combination of railways and railway interests, which finally was declared illegal by the U. S. Supreme Court. A third chapter of the same character, by Stuart Daggett, reviews the court decision requiring the dissolution of the merger of the Union Pacific and Southern Pacific railway systems. The three concluding chapters deal with foreign railway matters: 1, the English Railway and Canal Commission; 2, railway regulation in France, and 3, railway ownership in Germany.

New Carnegie "Pocket Companion"

POCKET COMPANION for Engineers, Architects and Builders, Containing Useful Information and Tables Appertaining to the Use of Steel—Pittsburgh, Penn.: Carnegie Steel Co. 16th edition. Leather; 5x8 in.; pp. 400; illustrated. $1.

The old Carnegie handbook, in its generation perhaps the most widely used manual of the structural engineer, saw its last reprinting ten years ago. Now a new Pocket Companion has been issued by the company, new in every respect, and far ahead of its predecessors. The new shapes are in the book, of course, and full data are given, down to formulas for the uniform dimensions (including the thickened junction of flange and web in the supplementary "thin-web I-beams up to 27-in.). The old Rolling Mill specifications have disappeared; the steel specifications of the American Society for Testing Materials, and the structural specifications of the American Bridge Co. (for structures other than bridges) are reproduced. Much other matter in the book, on designing and detailing, is also from the American Bridge Co.'s standards.

The modernized Carnegie throughout exhibits conscientious, intelligent selection of matter and careful editing. Its physical get-up is equally good. The book ought to become as popular as the old "Carnegie."

The increase of size over the earlier editions is interesting. The 5x8 size chosen makes a good page, and in spite of the true "pocket" size of the old book we believe the choice a good one.

SEWER DESIGN—By H. N. Ogden, M. Am. Soc. C. E., Professor of Sanitary Engineering, Cornell University. Second edition. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xii + 248; 71 text figures. $2 (8/6), net.

After fifteen years of use in his own classes and after sufficient use in other engineering schools and by engineers in practice to make the total printing to date run into a number of thousands, Professor Ogden has revised his lecture notes on "Sewer Design." The Preface to the present edition states that "certain minor errors" have been corrected and some additional matter inserted but that "the book as a whole is not materially changed." The number of pages, it may be added, has been increased by 14. The volume continues to be a useful brief elementary text on the design of sewers—supplemented by a companion volume on "Sewer Construction," by the same author (see notice of the latter in our issue of Dec. 17, 1908).

WORKMEN'S COMPENSATION AND INDUSTRIAL INSURANCE Under Modern Conditions—In two volumes. By James Harrington Boyd, Chairman, Ohio Employers' Liability Commission; member of the Toledo Bar; author of "Ohio Workmen's Industrial Insurance Law." Indianapolis, Ind.: The Bobbs-Merrill Co. Cloth; 6x9 in.; pp. xviii + 324, and xii + 276, respectively, and an appendix giving text, in English, of German Workmen's Insurance Code of 1911. A set, $9.

The rapid increase in the volume of legislation compelling employers to compensate their workmen or the workmen's families for injury or death due to accident while employed make timely this comprehensive work on that subject and on the closely related topic of industrial insurance. The author reviews the subject from the legal, economic and

historical viewpoints and presents full texts of statutes in force up to Jan. 1, 1913, in Germany, Great Britain and the United States, in the latter case, both federal and state excerpts from the legislation of other countries are also given. Matters common to the various American statutes are discussed. The book has its obvious value to large employers of labor, to libraries and generally to those who wish to be informed regarding these important phases of industrial sociology.

The Design of Aerial Flyers

[Review contributed]

THE RESISTANCE OF THE AIR AND AVIATION—Experiments Conducted at the Champ-De-Mars Laboratory. By G. Eiffel, Past President of La Societe des Ingenieurs Civils de France. Second edition, revised and enlarged. London, England: Constable & Co., Ltd., Boston and New York; Houghton Mifflin Co. Cloth; 10x12 in.; pp. xvi + 242; 124 illustrations and text figures, 27 folding plates; $10, net.

LEITFADEN DER FLUGTECHNIK; Für Ingenieure, Techniker und Studierende—By Siegmund Huppert, Direktor des Kyffhäuser-Technikums, Frankenhausen a. Kyffh. Berlin: Julius Springer. Cloth; 6x9 pp. ix + 368; 235 illustrations. 12 Marks.

In this book is France's most elaborate and important contribution to experimental aerodynamics, and one of the most valuable that has yet appeared. It presents the mature researches of a world-famous octogenarian engineer, aided by an expert staff, and working in a thoroughly modern laboratory of his own design, erected and furnished from his own ample fortune. The book is well translated by one of the best equipped of America's younger votaries of aëronautical science. The style of writing, printing and illustration has all the elegance, clearness and charm characteristic of Eiffel's works.

The present volume is the third in a series of memoirs on aërodynamics by M. Eiffel, and is more especially devoted to aëronautic surfaces and models. The first work, appearing in 1907, described his air resistance measurements with apparatus and models dropping from the Eiffel Tower; the second reviewed the resistance experiments of previous investigators; this memoir details the experiments made in the author's wind-tunnel in a small laboratory near the Tower. Together with its ample supplement, this memoir completes the story of all Eiffel's wind-tunnel experiments made at his Champ-de-Mars laboratory. The researches have in fact been continued, since 1912, in the new laboratory erected at Auteuil and provided with a more powerful air current, the results from which have not yet been formally or fully published.

"Resistance of the Air and Aviation" is really a triple book and should be divided in three parts, though the table of contents obscures this peculiarity.

Part I comprises three chapters and an appendix. The first chapter describes the equipment of the laboratory and the methods employed, explaining in detail Eiffel's instruments for measuring the air velocity, the resistance components, the center of pressure, the stream-line direction, the distribution of pressure at all points of the model surface, and finally the process of calculation from the experimental data obtained. The second chapter gives the results of experiments with plane surfaces held squarely to the wind and at various angels, with curved surfaces similarly treated, with parallel surfaces, with round bodies, and delineates the distribution of pressure. The third chapter gives the pressure measurements on various wing forms, some designed by Eiffel, others taken from well known aëroplanes, also on model aëroplanes, and explains how to select a suitable wing section for a practical design. The appendix contains the numerical results which are presented graphically in the text.

Part II, called the Supplement, comprises two chapters and an appendix. The first chapter, unlike the others of the book, is left without a general heading, but may be said to present further experiments with aërofoils and aëroplane models. It treats of oblique surfaces of different aspect ratios, effect of thickness, wings with reverse curvature, warped wings, staggered biplanes, tandem surfaces, multiplanes, aëroplane models, miscellaneous tests, and finally the choice of wings for a practical machine. The second chapter gives Eiffel's first propeller experiments. It describes Eiffel's method of testing propellers and of representing their action, his experimental results, and finally his conclusions. The appendix to this part gives the numerical data and derived results.

Part III is entitled "Later Experimental Research at the New Laboratory at Auteuil." It is much smaller than the other two parts, but would doubtless equal them in size if it contained all of Eiffel's later experiments. This part describes the building and equipment of the new and third laboratory, presents some most gratifying comparisons between model and full scale aëroplane measurements, and gives a brief account of Eiffel's new apparatus for testing model screw propellers.

Turning now from the form of the book to the nature of its contents, we find in admirable presentation the most important information in experimental aërodynamics needed in air-craft design since the development of practical aërial motors. True, Eiffel's wind-tunnel and measuring apparatus, however satisfactory to him, mark no great improvement and are not essential in the science. Equally uniform air streams and equally accurate measuring instruments were used by Eiffel's predecessors. But either because they withheld their methods and results, as in the case of the Wright brothers, or because their researches were not sufficiently extended for want of means, or were too academic or small of scale, those experimentalists had not furnished engineers with proportionately copious and substantial material for practical aërodynamic design. Eiffel, therefore, has done for aërodynamics what others were instrumentally equipped to do and should have done before him.

The general conclusion from these numerous and comprehensive experiments, which are too extensive and varied for present review, is very optimistic, but in substantial accord with that of competent aërodynamists for several decades past. All agree, to employ Eiffel's own words, ". . . . that laboratory experiments with reduced models furnish data of the greatest value to a designer of aëroplanes. Such tests may be made without the great expenditure of time and money required for the trials of a full size machine, and, moreover, without the peril of experimental flying.

"A series of laboratory experiments made upon a small model aëroplane, or upon wings of reduced size, easily and rapidly modified, form a rational basis for aëroplane calculations. Certain tests will determine the section of different parts according to the strength of materials, while other tests will demonstrate questions of equilibrium and stability, taking account of the weight calculated or assumed for each part. In short, the tests furnish all the elements of design.

"The same advantages are afforded by tests on model propellers under proper conditions. From experimental data it is possible to foresee the behavior of the actual propeller."

These statements seem optimistic enough; but when he announces that the resistance and sustentation of a full scale aëroplane can be foretold truly to 1% from experiments made on a model at the same speed, the report seems too good to be generally true. If that goal of accuracy be within sight, Eiffel may be regarded as the first to have announced its proximity and to have boldly proclaimed its attainment.

The translator of this work has done a valuable service to English-reading students of aëronautics. On the whole his translation is well done, though at times too free and hurried. In the following sentence, for example, one may be sure that Eiffel's habitual lucidity of thought and diction are not very happily emulated: "Full size experimental work is only required for a new type of machine whose behavior is in doubt, and, consequently, experimental flying is always dangerous."

For both style and substance Eiffel's book may well be recommended as a pattern for our engineers, and for those technical educators who are supposed to drill young men in the art of straight thinking and clear expression.

The second volume is a moderate-sized text-book on a large subject. The author, himself an engineer and director of a technical institute, endeavors to place in ready form for students, teachers and engineers generally, the best aviation material that has appeared in German and other literature. His work springs largely from his lectures for several years at the Kyffhäuser-Technikums in Frankhausen on the laws of air resistances, and their application to flying-machines; and is intended as an aid to other teachers of like subjects, and to their students. For the author believes the time not far distant when lectures on the theory and construction of flying-machines will find general admision in regular courses in the technical schools.

The text is largely qualitative and descriptive, though containing many useful data and some practical examples. The treatment where quantitative is light and effected by the most elementary mathematics. In so far it is suitable for beginners. On the other hand there are many references which, for lack of foot notes, mean nothing to such readers—references to original memoirs, experiments and unfamiliar apparatus. True, a bibliography is furnished as an appendix.

but it lists only nine books and seven periodicals. It totally ignores American and Italian aërotechnical literature and even the best produced of late in England. For every good book or pamphlet given in the bibliography half a dozen good works are omitted. Still it makes a beginning, and as such may be serviceable in paving part of the way to a systematic, comprehensive and thorough engineering work on aviation.

The book is well bound and well illustrated; the halftones and cuts are largely from original sources. The arrangement, however, is peculiar, there being neither chapters nor index. Twelve main headings, each with its subheadings comprise the whole text. But the topics overlap each other. For example the heading "Something about Aërodynamics" excludes the treatment of wind forces on plane and arched surfaces, these topics being treated under separate headings. "The Laws of Air Resistance" which is the first general heading, covers a hundred pages, of which only fifteen are devoted to aërodynamics, whereas nearly the whole material should come under this title.

The manner and matter of the text are entertaining, if somewhat too German. For example on the third page a single fourteen-line sentence gives the history and comparative merits of the various apparatus and methods of experimentation in aërodynamics. The sentence can convey no substantial information to the beginner, but may form a fair topic for one or two complete lectures. The matter of the book occasionally gives German investigators too much preference. Thus it ascribes to Francke and Prandtl the determination of atmospheric friction, though this had been published in America and England by Zahm several years previous to their researches. It carefully describes the prow of dead or motionless fluid before a plate held perpendicularly to the current in a stream of air or water, as reported by Von Lössel and by Ahlborn, whereas Marey in France, Hele-Shaw in England and Wm. Munroe White in America, not to mention many others, have proved that no such prow of dead fluid exists, but only a slowing of the fluid. At times the author seems to express views of his own which are not generally considered orthodox, as when, after too limited an investigation, he wetblankets the notion that higher speeds facilitate the maintenance of equilibrium of an aëroplane; or as when he concludes from his computation that the greatest speed attainable in an aëroplane is about that reached by Vedrines in 1912—say 110 miles an hour, a speed that was well exceeded in France in 1913, about the time Huppert's book was leaving the printers hands in Germany. Apart from such peculiarities of treatment, the book should furnish the reader much instructive and interesting material. The author does not indeed profess to be a discoverer or original investigator, but rather to present in readable form an ensemble of the science and art of aviation, as he finds them, and in this he does a valuable service. There is indeed a dearth of such summarizing works, and hence it might be well if this one were translated into other languages. It would be of especial assistance to practical designers of heavier-than-air craft.

Following the part on air resistance, fifty pages are devoted to the theory of aëroplane stability, then fifty to the art of constructing, launching and landing aëroplanes. Next, some eight pages are allotted to aëronautic materials, fifty to the theory and practice of the aërial screw, seventy to motors, and finally twenty some pages to details of well known types of machines, more particularly the earlier ones. To bring together so much good material in a new science is a large, a difficult task, and the author is to be felicitated on having performed it so well.

⁂

ROYAL COMMISSION ON SEWAGE DISPOSAL—Eighth Report, Vol. II. Appendix. Report to the Commission on the Results of Stream Observations, 1909-12, by Dr. G. McGowan, Colin R. Frye and G. B. Kershaw. London, England: Wyman & Sons or T. Fisher Unwin. Paper; 8x13 in.; pp. 202; illustrated. 2/9.

A valuable series of observations designed "to correlate actual effects produced by the discharge of sewage liquors or effluents [from sewage treatment works] into streams, with the result of chemical analysis [of both effluents and stream waters] making the stream itself the ultimate arbiter," is reported in this "blue book." The conclusions resulting from the studies formed the basis wholly or in part, for the notable standards for sewage effluents* given in the Eighth report of the Royal Commission on Sewage Disposal to which the present volume is a supplement.

Part I of the Appendix presents very concisely a description of some twenty-five sewage works, mostly small, with the character of their effluents expressed in tabular and text form and a statement of the effect of the effluents on the streams which receive them. Part II of the volume discusses the relative merits of the tests employed as correlated with riverside observations, besides giving other data gathered in the course of stream studies. Part III recounts some experiments in which various kinds of effluents were discharged through dry channels instead of into streams.

This Appendix, like all the earlier reports and appendices issued by the Commission, is a valuable contribution to the rapidly growing data on sewage treatment and the effect of sewage effluents on the streams into which they are discharged.

*See "Eng. News," Jan. 19, 1913, for a summary and editorial comment on these standards; also Dec. 19, 1912, for an earlier and briefer summary embodied in an editorial discussion. The Eighth report (not the present Appendix) is a thin volume which costs only 3d. in England.

⁂

A Valuable Book on Irrigation Engineering

PRINCIPLES OF IRRIGATION ENGINEERING—Arid Lands, Water Supply, Storage Works, Dams, Canals, Water Supply, Storage Works, Dams, Canals, Water Rights and Products. By Frederick Haynes Newell, Director, and Daniel William Murphy, Engineer in Charge of Drainage, United States Reclamation Service. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xiii + 293; 53 illustrations. $3, net.

The authors have succeeded remarkably well in presenting a concise, comprehensive and at the same time interesting exposition of not only the fundamental principles of irrigation engineering but also, by way of specific illustration, the best modern irrigation practice as well. It is true that as here given principles and practices alike, and particularly the latter, are those employed by the U. S. Reclamation Service, but the work of the Service is so extensive, so widely distributed geographically and topographically, and so varied in character as to serve admirably as a basis for a book on irrigation.

After brief introductory chapters the authors take up the practical side of their subject in a logical way, beginning with the water-supply itself and continuing with canals and their acessories until the small laterals which bring the water directly to the land have been covered. Then follow chapters on pumping, drainage, and operation and maintenance. This plan leaves water storage for later and detailed consideration, thus not breaking the continuity of the plan of following the water from the stream to the land by interjecting the eight chapters on water storage, reservoir sites, dam sites, timber, earth, rock-fill and masonry dams and outlet works. The two concluding chapters deal briefly with water rights and irrigation economics.

The illustrations have been well chosen and well reproduced and add materially to the interest and value of the book.

The object of the book has been well fulfilled. That object, the Preface states, is "to present the subject matter in such form that it may be read with profit by persons interested in irrigation, but without a thorough technical knowledge of the subject of hydraulics." Partly because the book has the aim just stated and partly because of its moderate size it deals chiefly with "the broader and more general aspects of the subject," expecting readers who may wish further details to go to "the many technical books now available." By adhering to this plan the authors have avoided "lumbering up" their book with tables of rainfall and related data and with discussions of hydraulics, the mathematical theory of dam design and other like matter in the vain attempt to supply the irrigation engineer with a single book which will enable him to dispense with all others.

The experience and position of the authors as well as the contents of the volume will make the book a welcome addition to engineering and general libraries, both as a semi-official account of the principles and practices followed by the U. S. Reclamation Service in its engineering work and as a treatise on "The Principles of Irrigation Engineering."

⁂

HANDBOOK ON SANITATION: A Manual of Theoretical and Practical Sanitation—By George M. Price, M. D., author of "Tenement House Inspection," "Epitome of Hygiene and Public Health" and "Hygiene for Nurses"; Director of Investigation, New York State Factory Commission. Third edition, rewritten and reset. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5x8 in.; pp. xi + 353; 25 illustrations. $1.50 (6/6), net.

Successive editions of this book show continuous improvement (see our issues of April 17, 1902, and Jan. 12, 1905, for notices of the earlier editions.) The second edition eliminated some of the engineering errors and misleading statements which doctors so frequently put into their books but the present edition still contains some of these blemishes. One which we did not mention in our notices

of the earlier editions is a statement that (p. 67) "about the right fall" for sewers has been determined to be 1 ft. in 40 ft. for 4-in. pipe, 1 in 60 for 6-in., 1 in 90 for 9-in. and 1 in 120 for 12-in. If this rule were followed sewage pumping machinery would indeed be in great demand, as a little figuring of resulting sewer depths will show. Notwithstanding some such blemishes the volume as it now stands is a useful small handbook for sanitary inspectors. The latest revision seems to have touched upon most of the recent advances in public health and sanitation which fall within the scope of the volume, but the touch is only a light one in some cases.

⁂

A Treatise on Office Organization

Reviewed by H. L. GANTT*

THE AMERICAN OFFICE: Its Organization, Management and Records—By J. William Schulze, Assistant Secretary, Alexander Hamilton Institute, New York; Lecturer on Office Organization and Management, New York University. New York: Key Publishing Co. Cloth; 6x9 in.; pp. 380; illustrated. $3, net.

In writing a book on "The American Office," Prof. Schulze has undertaken a large task, inasmuch as even after reading his book one is not entirely satisfied that there is such a thing as a typical American office. The mere fact, however, that the book gives much information concerning the office practice of some of the most successful business concerns gives it considerable value.

While much that the author says about the office is instructive, some of it seems so simple as to be obvious to anyone intelligent enough to have anything to do with office management. For instance he recommends that reflectors and glassware be periodically cleaned. In the next paragraph we find this very important recommendation:

> In making out specifications for painting give preference to kalsomine or cold-water paint for ceilings and side walls above the chair rails, as such material will stay absolutely white. Below chair rail, paint is preferable, as it can be washed.

The author strongly recommends indirect illumination, but says nothing about the heavy expense of it.

His comparison of wood and metal furniture in favor of wood is interesting and the statement in regard to the standardization of desk drawers is important. In the chapter on "Relation—Management and Employee," he recommends much that is good, including the day's schedule of work; but the idea of giving the exact number of minutes early and late for each employee looks like an unnecessary refinement.

The chapter on "Supervision and Salary Plans" has in it many helpful suggestions, intermingled with others which seem of very doubtful advantage.

The chapters on "Human Touch" and "Welfare Work" do not appear to have very much to do with office organization, and much of what the author calls welfare work may be put down as only ordinary common sense. It is being practiced by people who do not give it any special name.

The chapters on the "Physical Office" and "The Layout of Floor Space" are full of valuable suggestions, but the chapter on "Creating an Office Organization" is apt to give the idea that the real problem is planning the organization, which is not the case. The author evidently understands this, however, for he immediately follows this chapter with one on "Training Office Employees." The emphasis which he lays on this subject adds largely to the value of the book. He distinctly opposes "hiring and firing," the method usually employed; and believes firmly in training. He explains fully the cost of getting a satisfactory clerk, and makes clear that the training of office employees is very profitable. This chapter, however, is marred by such matter as the following, which he quotes under "Office Etiquette and Hints," from the general instructions given to employees of a manufacturing concern in Michigan: "Employees should be dignified, should not wrestle, skip or jostle in the corridors. These things make a bad impression on visitors and other employees." One naturally asks why the list of "Don'ts" is not made entirely complete.

Throughout the book the term "efficiency" is used frequently and loosely, being in many cases used where the term "economy" would be preferable. Machine work may replace hand work for the sake of economy, and it may be economical to make such a change even though the work done by the machine is not nearly as "efficiently" done as the hand work was.

In the chapter on "Office Employees" the author's recommendation concerning the answering of advertisements and his comments on university men are excellent; but his instructions how to interview an applicant do not appeal to the writer. It is true that application blanks of the type recommended are in use in certain concerns, but is is also true that some very desirable people have positively declined to fill out any such blanks. Further the reviewer is not sure that any really desirable person would be willing to fill out one of these blanks completely. Good men, as a rule, have no objections whatever to answering pertinent questions; but some of these questions impress one as impertinent.

In general it seems a pity that a book which has so much of value in it should be marred by so many poor illustrations.

*Consulting Engineer, 2915 Singer Building, New York City.

⁂

Engineering Data on the Catskill Water-Supply

THE CATSKILL WATER SUPPLY OF NEW YORK CITY—History, Location, Sub-Surface Investigations and Construction. By Labarus White, Assoc. M. Am. Soc. C. E., Division Engineer, Board of Water Supply. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xxxii + 748; 238 plates and text illustrations; $6, net.

Mr. White deserves commendation for bringing together in one volume a vast mass of data on one of the greatest engineering works ever undertaken. He gives as his object a desire "to present in reliable and readable form the history, location, design and construction of the Catskill Water Supply." As the author truly says there is much to be gained by a study of the work of several hundred engineers working in one of the largest and most efficient engineering organizations in the world, and in the methods of construction used by scores of the best contracting firms working with machinery made available by the proximity of the aqueduct to the great eastern centers of population and manufacturing industries.

The author's aim has been fulfilled so far as presenting an abundance of data on the design and construction of this great engineering work is concerned but he has failed to make his book either a history or readable, in the ordinary meaning of those terms.

The chief value of the book is in its collection of descriptions of engineering and construction methods, but the author fails to present his data in a way that would make it of greatest utility to the practicing engineer. Instead of selecting and describing parts of the work which are typical of the design and construction as a whole he has taken each section or contract separately and described the work of that section in detail. This not only tends to much duplication of essentially the same ind of engineering data but makes it next to impossible to use the book as a reference to the ways and means of the construction of any general or particular detail, unless its geographical location happens to be nown.

Notwithstanding this criticism the book is a valuable record of a magnificent engineering undertaking. It will undoubtedly be of great service to engineers engaged in similar work who can take the time to dig out and digest the data suited to their needs, as well as to writers of engineering textbooks.

⁂

ELEMENTS OF WATER BACTERIOLOGY, with Special Reference to Sanitary Water Analysis—By Samuel Cate Prescott, Associate Professor of Industrial Microbiology, Massachusetts Institute of Technology, and Charles-Edward Amory Winslow, Associate Professor of Biology, College of the City of New York and Curator of Public Health, American Museum of Natural History. Third edition, rewritten. New York: John Wiley & Sons, Inc. London, England: Chapman & Hall, Ltd. Cloth; 5x8 in.; pp. xiv + 318. $1.75, 7/6, net.

The first and second editions of this book were favorably noticed in our issues of July 14, 1904, and July 16, 1908, respectively. As we said, in effect, of the original edition, while the volume is essentially for students of water bacteriology it contains much information of use to water-works men who wish to keep posted or to stand ready to inform themselves on the bacterial purity of water-supplies and the significance of bacterial examinations. The new edition gives evidence of careful revision to cover the developments of the last five years.

⁂

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS—Proceedings of the Sixth Congress, New York, 1912. Two volumes. Issued by the Association: General Secretary's Office, 50, Nordbahnstrasse, Vienna II, Austria. Agents: New York: McGraw-Hill Book Co. London: E. & F. N. Spon, Ltd. Cloth; 6x9 in.; illustrated. $8.

The exceptional efforts made to procure papers for the Sixth Congress of the International Association for Testing Materials and the especial attention paid to the stenographic reporting of the tri-lingual proceedings have borne fruit in the two large volumes noted above. It is safe to say that

there has never been brought together so large and varied a collection of papers and discussions on the testing of materials. It is not to be expected that any engineer will wade through all of this information either as a pastime or as a task, but the admirable index makes the volumes very valuable for reference purposes, even though a continuous paging is not preserved. All of the foreign papers and discussions have been translated into English for the volumes circulated in English-speaking countries. Similar volumes also appear in French and in German.

Textbooks for Mechanics

Reviewed by R. R. POTTER*

SHOP MATHEMATICS: Part II, Advanced Shop Mathematics—Prepared in the Extension Division of the University of Wisconsin by Earle B. Norris, Associate Professor of Mechanical Engineering, and Ralph T. Craigo, Instructor in Mathematics. First edition. [Industrial Education Series.] New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xi + 214; 218 text figures. $1.50, net.

SHOP SKETCHING—Prepared in the Extension Division of the University of Wisconsin by Joseph W. Woolley and Roy B. Meredith, Sometime Instructors in Mechanical Engineering in the University Extension System. New York and London: McGraw-Hill Book Co. [Industrial Education Series.] Cloth; 6x9 in.; pp. ix + 102; 122 text illustrations. $1, net.

The character of this book is an outgrowth of the authors' five-years' experience in teaching shop mathematics in the extension division of the University of Wisconsin. It gives instruction in the use of algebra, geometry, trigonometry and logarithms. The method of presenting these subjects is not radically different from that of other texts, except that only the more practical and more commonly used features of each subject are dealt with and the problems presented are such as might come up for solution in shop practice.

The authors present the book as one suitable for home study and for use as a text in trade schools. It should fulfill its purpose admirably as a school text. In the reviewer's opinion, however, only the most exceptional machine-shop worker or apprentice could use it profitably for home study without personal instruction.

The second book noted above is another product of the University of Wisconsin extension division. Presented without its title and preface, it would pass anywhere as an ordinary text on mechanical drawing, notable chiefly for its admirable conciseness and for the omission of instruction in lettering and the traditional opening chapter on the selection and use of instruments. The preface, written by E. B. Norris, Associate Professor of Mechanical Engineering, outlines beautifully the requirements of a text "not intended to make draftsmen but to teach shop men the knowledge of drawing they need as shop men." The book itself, however, hardly fulfills these requirements. For example, the first chapter on the Principles of Mechanical Drawing, comprising nearly one-third of the book, gives information which is necessary and perhaps sufficient for the student in a technical high school. "Every good mechanic," however, has already acquired a satisfactory knowledge of these principles through his experience in the reading of drawings. We read in the preface that the mechanic "may be on a repair job which requires that a sketch be made of a broken part," but in the text the subject of drawing from objects is dismissed with a few perfunctory general remarks and a list of Dont's. One would expect considerably more on this subject in a book on shop sketching. What the shop man wants is working instructions on the actual technique of mechanical sketching—something along the line of C. W. Reinhardt's analytical instructions on lettering. The book is written too strictly from the viewpoint of the draftsman to make a strong appeal to the shop-bred mechanic.

AGRICULTURAL DRAFTING—By Charles B. Howe. [Wiley Technical Series for Vocational and Industrial Schools.] New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 11x8 in.; pp. vii + 63; 43 text illustrations and 26 plates. $1.25, net.

The application of the principles of mechanical drafting to meet the needs of agricultural students is the object of this book. There are sections on instruments, general instructions, kinds of drawings, working drawings, building construction and farm maps. The treatment seems adapted to the class of students already named. The book is one of a series on drafting, which series in turn is one of a larger "Technical Series."

---

*Assistant Manager and Production Engineer, Blood Bros. Machine Co., Kalamazoo, Mich.

The author takes occasion to instruct the users of his book on other matters than drafting. For instance he advocates "permanent and fireproof materials" for use in country buildings. Elsewhere he advises the installation of septic tanks, as if the septic tank were the sum and substance of sewage treatment and suited to all conditions. Introducing advice on subjects extraneous to drafting proper is questionable in a book on drafting, especially when the advice is sure to mislead the uninformed.

POWER PLANT TESTING: A Manual of Testing Engines, Turbines, Boilers, Pumps, Refrigerating Machinery, Fans, Fuels, Lubricants, Materials of Construction, etc.—By James Ambrose Moyer, M. Am. Soc. M. E., Professor of Mechanical Engineering, Pennsylvania State College and in Charge of the Engineering Experiment Station. Second edition, rewritten, enlarged and entirely reset. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xiv + 486; 393 text figures. $4, net.

In this second edition the author has variously brought his book uptodate (as by incorporating the new (1912) testing codes of the American Society of Mechanical Engineers) and filled in the few gaps which were noted by additions on smoke determinations, reports in general, testing lubricants and miscellaneous small details. A chapter has been added also, giving a proposed series of power-laboratory tests which might be used in the ordinary technical courses. For each test the apparatus is listed, the methods summarized in a few words, and what to report is plainly stated.

The first edition was attractive to teachers from its conciseness and broad scope (although at the expense of completeness as a manual of experimental engineering); the revision here seen increases its comprehensiveness without burdening it with details bewildering to the student.

AMERICAN SOCIETY FOR TESTING MATERIALS—Reports of the Committee on Preservative Coatings for Structural Materials, 1903-1913. Philadelphia, Penn.: Prof. Edgar Marburg, Secretary, University of Pennsylvania. Cloth; 6x9 in.; pp. 447; 92 illustrations. $2.50.

The Committee on Preservative Coatings for Structural Materials of the American Society for Testing Materials has been in existence since 1902 and has each year since that time presented an extensive report. During the early years of its existence this report was necessarily short and its prime interest was the discussion which it aroused, but since 1907, when a series of service tests on various bridges and test panels was instituted, the report has contained in addition to the usual discussion of current topics regarding paint for structural materials the annual report on the condition of these test structures.

Each annual publication of the American Society of Testing Materials has contained the report of this committee, but it has been found that the difficulty of following a certain test through four or five years was so great that it was decided at the last annual convention of the Society to prepare in one volume all of the reports of the committee. This volume has been published in the uniform style of the society publications and contains, as was intended, the entire literature of the committee. It is one of the most valuable contributions to the technology of structural paints available to the engineer. The only criticism which could be made of the compilation is that the reports of the various years are not sufficiently separated; so that on even more than casual inspection it is difficult to tell which year's report the particular page is taken from.

A TREATISE ON ROADS AND PAVEMENTS—By Ira Osborn Baker, M. Am. Soc. C. E., Professor of Civil Engineering, University of Illinois; author of "A Treatise on Masonry Construction" and "Engineers' Surveying Instruments." Second edition, enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. x + 698; 171 text figures and 68 tables. $5, postpaid.

The original edition of this volume was valued by itself and compared with other treatises on the subject in a lengthy notice which appeared in our issue of Feb. 19, 1903. A better idea of the way the volume met the needs of that and later days may perhaps be gained from the fact that with the present new edition 12,000 copies of the book have been printed.

The addition of a new chapter (42 pp.) entitled "Automobile Roads and Concrete Pavements" is the only apparent change in the present edition. This chapter summarizes new and changed practices which have followed and to a large extent been caused by the advent of the automobile and, as regards concrete, largely by the "development of the portland-cement industry." The main divisions of the chapter deal with dust suppression, protective coverings for water-bound macadam, bituminous macadam, and concrete roads. Construction methods are presented, with extracts from various specifications. The work of the author has been chiefly

that of a compiler; that is, the chapter contains little of the personality of the author, except as shown by his well known ability to condense and put in orderly fashion opinions and practices gathered from many sources.

Although the new chapter serves as a revision of the original merely in bringing a few topics up to date and adding a few others not included in the original edition, it materially increases the value of the book and should lead many who do not have the original edition to add the new one to their libraries.

New Edition of Jacksons' Alternating Currents

Reviewed by ERNST J. BERG.*

ALTERNATING CURRENTS AND ALTERNATING CURRENT MACHINERY. By Dugald C. Jackson, Past-President, Am. Inst. E. E., Professor of Electrical Engineering, Massachusetts Institute of Technology, and John Price Jackson, Fellow, Am. Inst. E. E., M. Am. Soc. M. E., Commissioner of Labor and Industry, Commonwealth of Pennsylvania State College. New edition, rewritten and enlarged. New York: The Macmillan Co. Cloth; 6x9 in.; pp. ix+968; 526 text illustrations. $5.50, net.

While the market is very nearly flooded with textbooks on electrical subjects, this book is welcome and will find a wide field of usefulness. It differs from other textbooks on alternating-current machinery and theory in several essential respects, which makes it of special interest, not only to students and teachers of electrical engineering, but also to young engineers who are doing practical work in the field.

In glancing over the pages one sees at once that it is rather more mathematical than the majority of textbooks. It involves a great deal of differential and integral calculus, as well as the simpler differential equations, all of which is very desirable. Furthermore, while the book, of course, deals with the fundamental principles of alternating-current theory, many of the discussions and problems are of intensely practical nature, and are, therefore, not given in ordinary textbooks.

The grouping of the subjects seems admirable, and there is no likelihood that the student's interest will fail as he labors through the book, because almost every page deals with some practical question explained in a scientific way.

The opening chapters deal with the generation of alternating electromotive force by coils revolving in magnetic fields. The waves generated are interestingly discussed and are analyzed by Fourier's series.

The chapters on the constants of electric circuits, and resistance, inductance and capacity in series and parallel connections are very clearly written, and numerous applications are given involving complex expressions as well as differential equations.

The chapters on polyphase circuits, usually very trying, are given clearly and the student will have little difficulty to find what happens when the load is balanced and unbalanced.

While the chapters on hysteresis and eddy currents are written on usual lines, sufficient new matter has been added to make them appear fresh. The constants of silicon steel and other alloys are given.

Much of the book is properly given to the transformer. Its characteristics are discussed from almost every conceivable point of view. It seems difficult at first to realize that so much space as is seen can be properly given to the synchronous generator and motor, but if read carefully, it is found that everything is of interest, and that little or nothing could well be left out.

The alternating-current motors and the asynchronous generator are very ably discussed. The book closes with some well written chapters on the determination of inductance and capacity in commercial circuits.

The book is unquestionably, in its field, one of the best that has appeared in recent years. It is a very fair and full summary of almost everything that has been published in the line of electrical engineering, and liberal references are made to the work of others.

THE NEW YORK SOCIETY OF ARCHITECTS—Year Book for 1913. New York City: Wm. T. Towner, Secretary, 529 Fifth Ave. Leather; 6x9 in.; pp. 306; illustrated. $5.

The New York Society of Architects issues this book annually for the benefit of its members. The present volume, however, is a valuable reference book for anyone engaged in building work in New York City. It contains among other things a list of the architects of New York State, the personnel of the city and state departments, a checking list for specification writing, the New York City Building Code, specially paragraphed and arranged for easy reference, and an abstract of the various laws and ordinances applicable to building in the greater city.

*Professor of Electrical Engineering, Union College, Schenectady, N. Y.

A Good Reinforced-Concrete Book

REINFORCED-CONCRETE CONSTRUCTION: Volume II, Retaining Walls and Buildings—Prepared in the Extension Division of the University of Wisconsin by George A. Hool, Associate Professor of Structural Engineering, University of Wisconsin. Engineering Education Series. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xvii + 666; 415 illustrations. $5, net.

The book noted above is the second of three volumes written by Prof. Hool for the Extension Division of the University of Wisconsin. The first, which was reviewed in "Engineering News," Oct. 17, 1912, p. 744, had for its subtitle "Fundamental Principles" and was devoted entirely to the theory of design of reinforced concrete, regardless of the type of structure. The third volume, which has not yet appeared, is among other things to take up bridge design and construction, but its complete scope has not been announced.

According to the preface of Vol. I, the book was written "primarily to meet the needs of those who desire to take up the study of the subject by correspondence," although there was, in the author's opinion, "apparently no reason why a text of this nature might not be employed for other purposes."

Vol. II is presumably intended for the same field as Vol. I but it is important to note that the word "correspondence" does not appear in the preface. In its stead is the statement that the book "has been prepared to meet the needs of students having varying qualifications." Whether or not this means that the author recognizes the difficulty of correspondence school study of such matter as Vol. II contains, it is a fact that his practice in writing for otherwise uninstructed students has led him into greater clarity of expression and arrangement than is common in engineering texts. In addition the inclusion in each section of a typical complete design greatly increases the value of the book for both study and reference purposes.

It is assumed by the author that the reader of the present book is acquainted with the general theory of reinforced-concrete design, either as expressed in the ordinary textbook or more particularly as expressed in Vol. I of his series. Therefore, all detailed investigations are not explained but are referred for the basic principles to the previous volume.

The book is in two parts, the first part on retaining walls having three chapters, and the second part on buildings having three sections, respectively design, construction, and estimates, making a total of 24 chapters in the second part. There is appended in full the second report of the Joint Committee on Concrete and Reinforced Concrete.

The three chapters on retaining walls are on the theory of stability, the design, and the construction. Prof. Hool states the standard theory of earth pressure, but criticises its use in the design of retaining walls on the ground of its frequent inaccuracy. He substitutes for this theory a rather curious empirical method of design whereby a reinforced-concrete retaining wall, of whatever type, is compared to a known solid retaining wall which has stood up under similar loading. From this comparison an estimate of the stresses in the reinforced-concrete wall may be made. Such a method, of course, depends upon the reliability of the data and the correctness of deductions therefrom on the solid walls.

The sections on the design of the wall, once the proper pressures have been obtained, are according to the standard methods and are very clearly expressed. Typical examples of different sizes and types of walls are given. The section on construction is quite brief, and not particularly instructive.

The first chapter on buildings, Chapter II, is headed "Floors." The chapter gives brief descriptions with drawings of the various types of floors used in concrete buildings, particularly the hollow tile and hollow metal form floors, with specific examples numerically worked out. Accompanying this are many drawings showing reinforcement and concrete layouts such as are used by actual concrete designers. Following this section is a section on cantilever flat-slab construction. Here, as in all the literature on the subject, the author is somewhat at sea. He presents the usual methods of design, which, as has often been said, are not the methods which are used by those patentees who build cantilever floors. Probably Mr. C. A. P. Turner, who has so vigorously opposed all the flat-slab theories except his own, would be equally opposed to the methods of design presented by Prof. Hool. They are, however, the conservative methods generally found in textbooks. Further on under "Floors"

a rather complete description of the so called unit construction, and finally, a few pages with drawings of floors of steel frames with concrete slabs or arches. In the last part of the chapter are paragraphs on loading, floor surfacing which, by the way, is quite inadequate), and on the various attachments to ceilings and floors, such as shaft hangers, etc.

Chapter V is devoted to types of reinforcement. It is particularly to be commended in that it does not describe in infinite detail the various peculiar conformations which have brief and correct form descriptions of the different wire been patented into reinforced-concrete bars. It does give in fabrics and the various "systems" generally used in reinforced-concrete construction in the United States. The next chapter, on "Roofs," takes up the waterproofing and drainage of concrete roofs, with little on the different kind of surfaces to these roofs, and finishes with a typical design worked out in detail.

Chapter VII, on "Columns," is a general discussion of column design. The author seems to be in favor of hooped columns, but, governed possibly by the pronunciamentos of the Joint Committee, hesitates to denounce the straight-rodded columns. This chapter also is followed by typical designs of reinforced-concrete columns. Chapter VIII, on "Foundations," has somewhat on the bearing capacity of soil, and gives designs of typical footings. The portion on footways is particularly good, and is one which is not found in similar detail in any other book. It is followed by an incomplete discussion of concrete piles.

Chapter IX, on "Walls and Partitions," is largely descriptive and contains a great amount of illustration, which rightly takes the place of text. The same may be said of Chapter X, on "Stairs"; it is brief and to the point. Chapter XI, on "Elevator Shafts," is rather out of place in the book. In order to make the treatment complete the author has felt called upon to give a discussion of elevators with illustrations of the different kinds of elevators and chapters on the selection of elevator types, etc. This does not seem to have a place in a book on reinforced-concrete buildings, inasmuch as elevators are not peculiar to such structures, and discussions of their design can readily be found in other books.

Chapter XII includes a number of good examples of methods of providing for contraction and expansion. It is only two pages long. Chapter XIII gets into some of the higher theoretical considerations of design. It takes up continuous beams in great detail. In this particular part the author seems to suffer from his desire to make the subject understandable to correspondence students. He therefore tries to avoid the use of the calculus, to the detriment of the treatment. It would probably have been much better to have treated the subject purely as appealing to one having a knowledge of the higher mathematics. The same may be said of Chapter XIV on "Eccentric Load Considerations in Columns," although the best part of this, for which the author gives credit to the very good English book by Messrs. Faber and Bowie, is more complete than in any other American treatment. Chapter XV, on "Wind Stresses," is brief and reasonably to the point. It takes up only five pages and necessarily cannot be complete in that space.

Chapter XVI gives the details of the design of a factory building, using the data of a reinforced-concrete designing company. Chapter XVII gives drawings and specifications of a building which has been built.

Section 2, on "Construction," starts at Chapter XVIII, which has the regular treatment on materials common to books on reinforced-concrete work. Chapter XIX, on "Forms," is also typical of some of the better classes of reinforced-concrete books, although it does contain a few more drawings than are given in most such books. Chapter XX is on bending and placing of reinforcement, a heading which explains itself. In Chapter XXI, on the "Proportioning, Mixing and Placing of Concrete," the various later methods of transporting concrete, particularly the chute method, are described, and precautions for placing concrete in freezing weather are noted. Chapter XXII, on "Finishing Conrete Surfaces," is commonplace, as is also Chapter XXIII on "Waterproofing."

Chapter XXIV is on "Construction Plant," and is written by A. W. Ransome, vice-president of the Ransome Concrete Machinery Co. It is very well done, and should be of value to any one designing such a plant. It may be noted, however, that Mr. Ransome assumes that 30 sec. is sufficient time for concrete to stay in the mixer, and states that concrete so mixed has been proved to be just as good as concrete mixed a much longer time. While this statement is categorical, it is well to call attention to the fact that it is only an opinion, and should have been backed up by data, even though the one having that opinion has had considerable experience. It is an opinion, however, that is held by a number of men, and is in need of proof or contradiction by a thorough set of tests.

Section 3 of the second part, on "Estimating," by Mr. Leslie H. Allen, of the Aberthaw Construction Co., Boston, outlines a method of estimating concrete in buildings such as is used by Mr. Allen's company, which should be in the knowledge of every one who is contemplating bidding on concrete building work.

We have gone thus thoroughly into Prof. Hool's book because we think that it deserves the attention of all who are interested in concrete design; it comes nearer to being a complete exposition of the field it is intended to cover than any other book on concrete.

❖

THE SOLDIER'S FOOT AND THE MILITARY SHOE: A Handbook for Officers and Noncommissioned Officers of the Line—By Edward Lyman Munson, M. D., Major, Medical Corps, United States Army; President, Army Shoe Board; Director, Field Service School for Medical Officers, Fort Leavenworth, Kan.; U. S. Cavalry Association. Cloth; 6x9 in.; pp. 147; 54 illustrations. $1.35.

The proper care and covering of the feet is almost as important a matter to the engineer and contractor in the field as to the soldier on the march, considering the latter as an individual rather than a unit of the army. This book summarizes studies made by the Army Shoe Board, describes the military shoe devised by the Board, and has chapters of much general interest and value on the care of the feet, on the sock, and on the care of shoes. Many of the qualities claimed for the new military shoe are equally desirable for any man who is on his feet a large part of the time, particularly for the man who takes long country walks for business or pleasure.

❖

A half dozen papers on ventilation and related topics fill the larger part of the November issue of "The American Journal of Public Health" (289 Fourth Ave., New York City; 20c.) The authors are D. D. Kimball, Stephen De M. Gage and Professors Earle B. Phelps, Frederic Bass, George C. Whipple and Melville C. Whipple and W. L. Holman. The latter deals with "The Bacteriology of Soot"—from the air of Pittsburgh.

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in cast of books or papers privately plinted, then to the author or other person indicated in the notice.]

ABWASSERBESEITIGUNG BEI GARTENSTADTEN, BEI LANDLICHEN UND BEI STADTISCHEN SIEDELUNGEN—Von Prof. Dr. K. Thumm, Abteilungsvorsteher an der Kgl. Landesanstalt fur Wasserhygiene, Berlin-Dahlem. Berlin: August Hirschwald, NW., Unter den Linden 86. Paper; 7x10 in.; pp. 26; illustrated. 1.50 Marks.

ADVERTISING AND SELLING—Principles of Appeal and Response—By Harry L. Hollingworth, Instructor in Psychology in Columbia University; Lecturer in Business Psychology, School of Commerce, New York University. [Published for the Advertising Men's League of New York City, Inc.] New York: D. Appleton & Co. Cloth; 5x8 in.; pp. xiii + 314; illustrated. $2, net.

AMERICAN SOCIETY FOR TESTING MATERIALS—Proceedings of the Sixteenth Annual Meeting, Atlantic City, N. J., June 24-28, 1913. Philadelphia, Penn.: Prof. Edgar Marburg, University of Pennsylvania. Cloth; 6x9 in.; pp. 1141; illustrated.

CANADA MINISTERE DES MINES, Ottawa, Ont., Can. Paper; 7x10 in.; illustrated.

Rapport sur les Depots de fer Chrome des Cantons de L'Est de la Province de Quebec—Par Fritz Cirkel. Pp. 145.

Rapport sur les Minerais de Tungstene du Canada—Par T. L. Walker. Pp. 56.

Enquete sur les Tourbieres et L'Industrie de la Tourbe en Canada, Durant la Saison 1909-10—Par Aleph Anrep, Jr. Bulletin No. 4. Pp. 48.

Mineraux Industriels et Industries Mineres du Canada—Par Le Personnel de la Division de Mines. Pp. 85.

CHIEF INSPECTOR OF EXPLOSIVES, UNION OF SOUTH AFRICA—Annual Report for Calendar Year Ended Dec. 31, 1912. Johannesburg: Mines Department. Paper; 8x13; pp. 20.

COMMISSIONER OF SOUTH AUSTRALIAN RAILWAYS—Annual Report for the Year 1912-13. Adelaide: Commissioner's Office. Paper; 8x13 in.; pp. 48; illustrated.

THE APPROXIMATE MELTING POINTS OF SOME COMMERCIAL COPPER ALLOYS—By H. W. Gillett and A. B. Norton. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp.9.

AUSTRALIAN INTER-STATE CONFERENCE ON ARTESIAN WATER—Report of Proceedings, May, 1912. Sidney, N. S. W.: E. F. Pittman, Chairman, Government Geologist and Under Secretary for Mines, N. S. W. Cardboard; 8x13 in.; pp. 275; portfolio containing numerous maps and plates.

THE CITY MANAGER PLAN OF CITY GOVERNMENT [Reprinted from Beard's Loose-Leaf Digest of Short Ballot Charters.] New York: The National Short Ballot Organization, 383 Fourth Ave. Paper; 8x10 in.; pp. 35. 25c.

Up to Oct. 15, 1913, the city manager plan had been adopted by seven cities in the United States. Provisions relating to the city manager in each of these cities are reprinted here, as well as proposed provisions which have failed of adoption elsewhere. Several papers outlining or advocating the city manager plan are also reprinted.

CITY-PLANNING: A Comprehensive Analysis of the Subject Arranged for the Classification of Books, Plans, Photographs, Notes and Other Collected Material, with Alphabetical Subject Index—By James Sturgis Pray, Chairman, and Theodora Kimball, Librarian; School of Landscape Architecture, Harvard University. Cambridge, Mass.: Harvard University Press. Paper; 7x10 in.; pp. 103. $1.

DER DIESELMYTHUS; Quellenmassige Geschichte der Entstehung des heutigen Olmotors—Von T. Luders, Fruher Professor an der Kgl. Technischen Hochschule zu Aachen. Berlin: M. Krayn. Paper; 6x9 in.; pp. 236; 12 text figures. 4.50 Marks.

ELECTRICAL BLUE BOOK: The Buyers' Guide of Electrical Material. Sixth edition. Chicago, Ill.: Electrical Review Publishing Co. Cloth; 9x12 in.; pp. 227; illustrated. $2.

FLOOD PROTECTION FOR THE CITY OF COLUMBUS, OHIO—A Report to the Mayor and City Council by John W. Alvord, Sept. 15, 1913. Chicago, Ill.: Alvord & Burdick, Engineers. Paper; 6x9 in.; pp. 325; illustrated.

THE GAS WORKS DIRECTORY AND STATISTICS, 1913-14, with a List of Chairmen, Managers, Engineers and Secretaries, and Lists of Associations of Engineers and Managers. London: Hazell, Watson & Viney, Ltd. Cloth; 6x9 in.; pp. 563. 10/6 net.

A variety of useful information regarding the gas works rules of England and Wales, Scotland, Ireland and some "foreign" cities is given in this annual. The statistics are both financial and physical in character. Charges to private consumers and for public lamps are given.

GENERAL SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE, Including Finishing and Waterproofing—By Jerome Cochran, Jun. M. Am. Soc. C. E., author of "Cement Specifications," "Inspection of Concrete Construction," etc. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. xxiii + 274; 21 text figures. $2.50, net.

GOVERNMENT OWNERSHIP OF RAILWAYS—By Samuel O. Dunn, Editor of the "Railway Age Gazette"; author of "The American Transportation Question." New York and London: D. Appleton & Co. Cloth; 5x8 in.; pp. vii + 400. $1.50, net.

GRAPHICS AND STRUCTURAL DESIGN—By H. D. Hess, M. Am. Soc. M. E., Professor of Machine Design, Sibley College, Cornell University; formerly Designer and Computer for the Mechanical Department of the Pencoyd Iron Works and the American Bridge Co. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. viii + 426; 429 text figures. $3 (12/6), net.

THE GYPSUM AND SALT OF OKLAHOMA—By L. C. Snider. Norman, Okla.: Oklahoma Geological Survey. Bulletin 11. Cloth; 6x9 in.; pp. 214; illustrated.

HANDBOOK FOR MACHINE DESIGNERS AND DRAFTSMEN—By Frederick A. Halsey, M. Am. Soc. M. E., Editor Emeritus of "The American Machinist"; author of "Slide Valve Gears," "The Use of the Slide Rule," "Worm and Spiral Gearing," "The Metric Fallacy," etc. New York and London: McGraw-Hill Book Co., Inc. Cloth; 8x11 in.; pp. ix + 494; 700 line drawings. $5 (21/-), net.

INDUSTRIAL CHEMISTRY FOR ENGINEERING STUDENTS—By Henry K. Benson, Professor of Industrial Chemistry in the University of Washington. New York: The Macmillan Company. Cloth; 6x8 in.; pp. xiv + 431; 52 text illustrations. $1.90.

IOWA DEPARTMENT OF FINANCE AND MUNICIPAL ACCOUNTS—Sixth Annual Report, For Fiscal Year Ended Mar. 31, 1913. Des Moines: John L. Bleakly, Auditor of State. Cloth; 6x9 in.; pp. 271.

LOGGING; The Principles and General Methods of Operation in the United States—By Ralph Clement Bryant, Manufacturers' Association Professor of Lumbering, Yale University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xviii + 590; 133 illustartions. $3.50 (15/-), net.

MECHANICAL REFRIGERATION; A Treatise for Technical Students and Engineers—By H. J. Macintire, M. Am. Soc. M. E., Assistant Professor of Mechanical Engineering, University of Washington. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. ix + 346; 121 text figures. $4, net.

THE MINERAL INDUSTRY OF NEW JERSEY FOR 1912—By M. W. Twitchell, Assistant State Geologist. Trenton: Geological Survey of New Jersey. Paper; 6x9 in.; pp. 43.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS—Reports; Vol. I, May 1, 1911 to June 2, 1913. Trenton, N. J.: The Board. Cloth; 6x9 in.; pp. 754.

OFFICIAL YEAR BOOK OF THE COMMONWEALTH OF AUSTRALIA, Containing Authoritative Statistics for the Period 1901-1912, and Corrected Statistics for the Period 1788 to 1900. Melbourne: Commonwealth Bureau of Census and Statistics. Stiff cardboard; 6x9 in.; pp. 1236.

PRACTICAL PATTERN MAKING: A Practical Work on the Art of Making Patterns, Written by a Pattern-Maker with Thirty Years' Experience—By F. W. Barrows. Second edition, revised and enlarged. New York: The Norman W. Henley Publishing Co. Cloth; 5x8 in.; pp. 3[illegible]; 159 illustrations. $2.

PRACTICAL USES OF THE WAVE METER IN WIRELESS TELEGRAPHY—By J. O. Mauborgne, First Lieutenant, 24th U. S. Infantry; formerly Instructor, Army Signal School, Fort Leavenworth, Kan. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. viii + 74; [illegible] text figures. $1, net.

PROBLEMS IN PHYSICS (Based upon the "Text-Book of Physics," Edited by A. Wilmer Duff)—By Morton Masius, Department of Physics, Worcester Polytechnic Institute, Philadelphia, Penn.: P. Blakiston's Son & Co. Paper; 5x[illegible] pp. 23. 10c. (free to students using Duff's "Text-Book").

These problems have been based on the last edition of "Text-Book of Physics" by Duff and others, reviewed in "Engineering News," Jan. 16, 1913, p. 138. These are of wider utility, however, for all teachers who have use for all available collections of problems.

PROVINCIAL BOARD OF HEALTH OF ONTARIO, CANADA—31st Annual Report, For the Year 1912. Toronto: John W. S. McCullough, M. D., Secretary and Chief Officer of Health. Paper; 7x10 in.; pp. 496.

PURIFICATION OF WATER FOR RESIDENCES—By John R. Dunlap, Department of Civil Engineering, State University of Iowa, Iowa City, Iowa. [Reprint from the Proceedings of the Iowa Engineering Society for 1913.] Paper; 6x9 in.; pp. 11; illustrated.

QUESTIONS AND ANSWERS RELATING TO AUTOMOBILE DESIGN AND CONSTRUCTION, DRIVING AND REPAIR: A Self-Instructor for Students, Mechanics and Motorists—By Victor W. Page, author of "The Modern Gasoline Automobile" and "Location of Gasoline Troubles Made Easy." New York: The Norman W. Henley Publishing Co. Cloth; 5x8 in.; pp. 608; 329 illustrations. $1.50.

REGISTRATION OF BIRTHS, MARRIAGES AND DEATHS IN THE PROVINCE OF ONTARIO, For Year Ended Dec. 31, 1912 (Being 43rd Annual Report)—Report of W. J. Hanna, Registrar-General of Ontario, Toronto, Can. Paper; 6x9 in.; pp. 430.

REPORT OF CHERRY CREEK FLOOD COMMISSION, May, 1913—Denver, Colo.: Board of Public Works. Cloth; 6x9 in.; pp. 159; illustrated.

REPORT OF THE INDUSTRIAL COUNCIL OF THE BRITISH BOARD OF TRADE ON ITS INQUIRY INTO INDUSTRIAL AGREEMENTS—Washington, D. C.: Bureau of Labor Statistics. Paper; 6x9 in.; pp. 41.

REPORT ON THE COLLECTION AND DISPOSAL OF REFUSE IN THE VILLAGES OF WINNETKA AND GLENCOE—Winnetka, Ill.: Chas. Fuller, Chairman Joint Committee, Winnetka Village Improvement Association, Glencoe Women's Club and Glencoe Men's Club. Paper; 6x9 in.; pp. 26.

SELECT LIST OF WORKS RELATING TO CITY PLANNING AND ALLIED TOPICS—New York: The New York Public Library. Paper; 7x10 in.; pp. 35.

STANDARD REGULATIONS FOR MANUFACTURED GAS AND GAS SERVICE—Washington, D. C.: Bureau of Standards. Circular 32. Paper; 7x10 in.; pp. 169.

SUSPENSION BRIDGES AND CANTILEVERS; Their Economic Proportions and Limiting Spans—By D. B. Steinman, Professor of Civil Engineering, University of Idaho. Second edition, revised. New York: D. Van Nostrand Co. Linen; 3x6 in.; pp. 185; illustrated. 50c., net.

SUSPENSION BRIDGES, ARCH RIBS AND CANTILEVERS—By Wm. H. Burr, M. Am. Soc. C. E., Professor of Civil engineering, Columbia University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xi + 417; illustrated. $4.50, net.

THREE PAMPHLETS ON WOOD-USING INDUSTRIES—By Hu Maxwell, Expert, and John T. Harris, Statistician, U. S. Forest Service. Paper; 6x9 in.; illustrated.

Wood-Using Industries of Florida. Tallahassee: State Department of Agriculture. Pp. 85.

Wood-Working Industries of Iowa. Ames: Agricultural Experiment Station, Iowa State College of Agriculture and Mechanic Arts. Pp. 304.

Wood-Using Industries of Minnesota (Including "Timber Resources of Minnesota," by Wm. T. Cox, State Forester). St. Paul: State Forestry Board. Pp. 87.

TRADE AND CUSTOMS AND EXCISE REVENUE OF THE COMMONWEALTH OF AUSTRALIA For the Year 1912. Melbourne: Commonwealth Bureau of Census and Statistics. Cardboard; 8x13 in.; pp. 629.

TRIANGULATION ALONG THE WEST COAST OF FLORIDA—By Clarence H. Swick, Computer. Washington, D. C.: U. S. Coast and Geodetic Survey. Paper; 9x11; pp. 147; illustrated.

UNITED STATES BUREAU OF MINES, Washington, D. C. Paper; 6x9 in.; illustrated.

Safety in Tunneling—By David W. Brunton and John A. Davis. Miners' Circular 13. Pp. 19.

Mine-Accident Prevention at Lake Superior Iron Mines—By Dwight E. Woodbridge. Technical Paper 30. Pp. 38.

Coal-Mine Accidents in the United States and Foreign Countries—Compiled by Frederick W. Horton. Bulletin 69. Pp. 102.

A Preliminary Report on Uranium, Radium and Vanadium—By Richard B. Moore and Karl L. Kithil. Bulletin 70. Pp. 101.

Manufacture of Lime—By Warren E. Emley, Assistant Chemist. Technologic Paper 16. Pp. 130; 7x10 in.

YELLOW PINE; A Manual of Standard Wood Construction. Prepared and Compiled by Arthur T. North, Assoc. M. Am. Soc. C. E. St. Louis, Mo.: The Yellow Pine Manufacturers' Association; Geo. K. Smith, Secy., Wright Bldg. Paper; 4x7 in.; pp. 130; illustrated.